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UNASYLVA

The FAO Conferences at Quebec and Copenhagen clearly established the aims to be set for *Unasylva*:

1. To keep foresters and technicians throughout the world informed of new achievements and developments in the fields of forestry and forest products.
2. To supply regular information about particular problems with which FAO's Division of Forestry and Forest Products is grappling and about the work undertaken by the technical officers of the Organization.
3. To furnish items of news from all over the world about what is being done in the field of forestry and forest products.
4. To provide statistical data and general information concerning output of wood products, trade, and industry.

Unasylva is therefore divided into four parts.

The first part contains articles by foresters and technical experts of international repute and by the division's own technical officers, working as a team. These articles attempt to show forestry and timber technicians what is being done in other countries and what it is possible to achieve in wood production and in better utilization. They should also serve to draw attention to certain problems, offer analyses, and persuade our readers to contribute to their solution.

The second part contains what we have termed national situations. Those responsible for the forestry policies of their countries have been asked to contribute surveys of the current situation and plans for the future. This section will include a continuing series on national forest policies, on the timber balances of the different countries, on the organization of forestry and forest products research.

The third part reports on the activities of FAO's Division of Forestry and Forest Products. It contains information concerning the organization of the division, its projects, and its present and future work.

Part four brings a brief survey of world news on forestry and forest products. It contains information on new legislation, new methods and processes, wood utilization, trade, and industry.

It is further intended to publish statistical supplements dealing with world trade and forest products.

This outline of the publication's scope is the fruit of much thought and discussion by the technical staff of the Division of Forestry and Forest Products, but we have never thought of it as immutable. Our aim is to contribute a useful publication and to present it as attractively as possible. We hope to have it read by an ever-increasing number of readers. We want our readers to help us by making suggestions and telling us how we might make this review more useful and interesting.

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Aberglaslyn Pass, North Wales.
(Photo by courtesy of British Information Service.)

The Economic Foundations of Forest Politics

By A. HOWARD GRON

Editor's Note. *In view of special features of the thesis presented by the author, he has preferred the broad term "forest politics" to the more commonly used English term "forest policies."*

THE term "forest politics" is intended to mean the sum of measures taken by the state or the municipality to safeguard public interest in regard to forests and forestry.

There may be considerable disparity between private and public interests in forestry. This is due to the fact that a forest may present one group of utilities to the individual owner but a different group to the community at large.

The individual utility of forests lies mainly in their production of material goods, such as wood and timber, for which there is a market. The balance between supply and demand for these products is maintained by the free interplay of price-determining factors. By selling his products, the forest owner obtains a certain gross revenue in money. He can easily compare his expenditure and income and determine whether the way he manages his property is profitable or not.

The public utility of forests may not be connected at all with the value of their products but may be measured in terms of climatic influence, regulation of stream flow, or the importance of domestic wood production as a source of employment. It produces no goods for sale on the market, prices do not enter into the picture, and no income accrues to the individual forest owner. The public utility values of forests and forestry, therefore, are entirely omitted from the balance sheets of private enterprises, with the result that privately owned forest property is managed as if no public utility factor were involved at all.

But although this public utility value is not marketable, any community that attains a certain cultural development must determine its forest politics in order to ensure and if possible develop the intangible assets of its forests. It has been said that the forest politics of a state are the best yardstick of the cultural conscience of its people.

Fundamental Economic Principle in Forest Politics

Forest politics imply foresight and social self-control. This does not mean, however, that any form of public utility capable of being derived from the forest must be secured regardless of cost. The community or the state, as well as the private forest owner, must decide whether it will or will not be worth while to produce any given form of utility. Owing to the lack of automatic price adjustment for the collective forms of utilities, this decision often becomes rather difficult and only an approximation is possible.

Private and community balancing of costs against expected returns have one thing in common: the means of production are scarce. In both cases the fundamental consideration in situations of scarcity has to be observed, i.e. the scarce means should be so apportioned among the different possibilities of production that the maximum total utility is obtained.

In private enterprise the balancing is easily done. Here money value of the products is accepted as the measure of utility. Expenditures of money are costs, receipts of money are revenues, and comparison of receipts and expenditures shows the net profit. The profitability of any given enterprise as expressed by the earning capacity of the capital investment can then be compared with the profitability of other enterprises. Under ideally free economic conditions capital would naturally move from enterprises with a low profitability to enterprises with a high profitability, and thus available resources would be used in accordance with the valuation of different utilities through the price-fixing process of a free market.

When a community, however, has to calculate the cost of public utility values in order to establish a balance, the whole picture changes. Expenditure need not be money costs, benefits need not be money revenue. The balance cannot be figured in money at all. The true cost of producing utility of one kind is the loss of utility of another kind that might have been produced with the same means of production. In these cases it is necessary to think in terms of nonmaterial utilities rather than in terms of money. So far in most countries forest politics have not had much regard for this fundamental economic principle. Forest politics should be based not on what the government can put into immediate operation but on what the community can afford.

Growth of the Public Utility Concept in Forestry Legislation

The Romans were already aware of certain collective utilities to be derived from forests. The *Lex duo decim tabularum* put into force in 450 B.C. contains provisions against devastation of the forests, and Cicero characterized those enterprising people who cut down the forests of Macedonia as enemies of the state.

In the Middle Ages there seems to have been no concern about the forests for their common utility value, but in the countries of central Europe private rights in the forest were strongly defended (*Lex sali-*

ca, Lex Burgundionum, etc.) by rough punishments for such acts as setting fire to the forest, tearing off the bark from old oaks, or cutting in private enclosures.

The oldest cases of preservation of forests as protection against catastrophes such as avalanches were recorded in Switzerland in the Canton of Schwyz in 1343 and in the Canton of Uri in 1383. In the course of time the rulers of European countries put many local forest ordinances into effect. They wanted to regulate cutting in order to maintain a constant local wood and timber supply, since transport facilities were so poor that it was impossible to move bulky cargoes over long distances at reasonable cost. However, it is equally apparent that the ruling class, which was behind these old forest ordinances, was also very much concerned with the preservation of the forests for their hunting.

One of the outstanding achievements in forest politics was Colbert's classic *Ordonnance des Eaux et Forêts* of 1669 for France. Its motive was a concern which, together with hunting, influenced forest politics in many countries; this was the collective utility of forests as providers of material for building warships. To rule the waves, it was necessary to possess big oak forests within the frontiers of the country. This is very clearly illustrated by England's forest politics. In 1588 the Spanish Armada, aiming at the south coast of England, had been ordered first of all to destroy the royal forests after invading England. Following such a destruction England would not have been able to build another navy within a hundred years. Events turned out otherwise, however. After the miraculous destruction of the Spanish Armada, the English Government realized the danger and ordered vast new oak forests to be planted farther inland, but interest in this enterprise soon lagged. About a hundred years later England's struggle to overcome Dutch sea power once more made it concerned with planting oak forests. At this time, one of the first textbooks on forestry was written: *Silva, or a Discourse of Forest Trees and the Propagation of Timber in His Majesty's Dominion,* by John Evelyn.

Once again, the concern of the Government about growing forests in England vanished until, after another century, it was revived with the Napoleonic Wars. Then enormous sums were made available for the planting of forests, but not much had been achieved before the replacement of wooden ships by an iron navy definitely abolished the collective utility of forests for maritime warfare. After that, forestry became a "lost art" in England. Nevertheless, during the first World War, when Great Britain found itself cut off from continental wood and lumber markets, a new era of forest planting was inaugurated for the fourth time.

Up to about 1800 the French forest ordinance of 1669 served as a model of forestry legislation for a number of European countries. Then, under the influence of Adam Smith's economic theories, forestry legislation was repealed in most countries. This happened as early as 1791 in France, 1795 in Norway, 1805 in Finland, 1811 in Prussia, and 1828 in Sweden. Furthermore, vast areas of state forests were put up for sale. In France about 1,000,000 hectares of forest passed from state to private ownership between 1807 and 1823. Only in Denmark did development tend in the opposite direction: in 1805 government control of private forest management, established in 1681, became more stringent; devastation of forests was strictly prohibited; all existing forests were to be treated as enclosures wherein the grazing of cattle or other animals was prohibited. Slightly amended in 1935, this act is still in force.

In many parts of Europe extensive devastation of the forests took place following the abolition of government control of cutting and the sale of state forests. The same period brought unusual climatic conditions—scarcity of rain in some places, and elsewhere abundant rainfall and numerous avalanches, torrents, and floods. This gave rise to a strong but only vaguely substantiated idea of the influence of forests upon precipitation, stream-flow regulation, and many other phenomena of nature. These ideas have survived to the present day, although for a long time it was impossible to establish scientific evidence for them. Only in a few instances was the collective utility of the forest obvious—that is, in protection against avalanches and torrents.

In some European countries special legislation on the management of protection forests was passed. By passing a very rigorous forest act in 1852, Austria became the leading country in this respect; it was followed in 1860 by France, in 1876 by Switzerland, and in the course of the following 25 years by practically all the other countries on the Continent.

From the public concern about forests for their protective functions grew concern about their social and economic utility as a source of raw material within the national borders for timber and wood-working industries. This led to the passing of a series of forest laws in various countries concerning private forests. In most countries clearing of forest areas was forbidden unless such areas should afterwards be used for other productive purposes, chiefly agriculture, or be reforested. The Swedish forest act of 1903, re-enacted in 1923, formulated this principle by stating that cuttings in mature stands must not be made at such a rate as to endanger the possibility of self-regeneration.

During the years between the two world wars nearly all European countries revised their forestry legislation, and some of the new or re-established countries passed very stringent laws, for instance Poland in 1927 and Czechoslovakia in 1928.

This development within European forest politics is obviously due to the general trend of world economy after World War I away from free trade and towards self-sufficiency and protectionism. It is further one of the many aspects of the world-wide problem of protecting the national currency against devaluation and of securing within the national borders employment for all able citizens. To do justice to these developments, it would be necessary to go much further into theoretical consideration of a rational economic approach to forest politics than is necessary in dealing with the protective utility of certain forests.

Rational Economic Approach to Forest Politics

Where it is a question of private investment in forestry, the profit obtainable for the capital investment is the crucial point. Labor must be paid according to current labor-union agreements. For a few forests situated in very fertile regions, a certain ground rent must be calculated as well, since such a rent would be

obtainable by the growing of crops other than wood. But in most cases forest soils are of so poor a quality or the situation of the forest areas is so remote that only the growing of forests is feasible. In such cases no ground rent should be calculated. What is left after payment of wages can be considered interest on the capital investment. Should calculation show a rate of profit equalling or exceeding the average rate for investments in other fields, forestry will be continued as a satisfactory commercial enterprise. If not, all private capital will be withdrawn from the forests, i.e. all stands which can be realized at a profit will be cut down unless such a course of action is prevented by legislative measures and due control.

In balancing costs and returns of forestry operations undertaken to develop social utilities, forest economists are apt to use a corresponding method. The probable return on the capital investment is calculated; and in case of a deficit, a further balancing of the deficit against the estimated values of collective utility derived from the forestry in question is undertaken. However, this method is rational only if collective utility is dealt with, e.g. protection against torrents or the value of the forest for recreation. If the forest as a source of employment and national supply is under consideration, an entirely different method of balancing has to be used.

If one considers how the maximum national production can be obtained, labor is the weakest link in the chain. This was already the case in the entirely free interplay of liberal economic conditions before the labor unions emerged, and nowadays it is even more so, because no civilized community would permit the free regulation of labor supply through starvation. If a man cannot support himself and his family, the community takes care of him and keeps him alive. In one way or another, according to the development of social foresight in the country concerned, he will get his share, modest though it may be, of the total national income even though he himself does not contribute to its creation. Under these circumstances it is of the utmost importance from the point of view of the community that everybody should contribute to the national income by performing some kind of work, even if the value of his work does not offset the value of what he consumes and lies far below union wages.

In private enterprise the marginal utility of a worker must be the equivalent of his wages. In an enterprise run by the state or the municipality, insofar as there is unemployment, even a submarginal utility is worth while. In practice this means that in balancing state or municipal enterprises, first and foremost a reasonable interest on the capital investment must be deducted. What is left can be considered as earned by labor. As such, however slight it may be, it justifies the start or the continuation of the enterprise in question from a social point of view since it will lead to a higher total effective income than unemployment.

This gives rise to a very difficult practical problem of social policy. Private enterprises abandoned as nonremunerative on account of the discrepancy between labor-union wages and the marginal utility of the laborer might, if continued, contribute a considerably higher amount to the total national income than new state enterprises, started in order to combat unemployment but having an even lower submarginal utility of labor. The solution lies in state subvention of private enterprise directly or indirectly through protective tariffs or other measures.

Particularly in the case of forestry and forest policies, two possibilities must be considered. One is the planting of forests on denuded areas. The other is the conservation of existing forests and the converting of forestry practice from periodical exploitation to sustained yield through adequate legislative measures. Both possibilities create employment in areas which hitherto did not contribute at all or contributed only slightly or occasionally to employment. Furthermore, national production of raw materials is increased, which in its turn results in higher employment and a better standard of living for more people. During the years between the two world wars unemployment was a predominant factor in most European countries. This accounts for the great interest and lively activity in forest politics in those years.

A new period of unemployment was expected after World War II; but in some of the European countries with great forest areas, just the opposite has been the case. War losses, together with a diminishing birth rate starting 20 years ago, have reduced the number of young laborers now becoming available. A strong tendency to move from the land to the city to look for industrial employment has aggravated the shortage of agricultural and forest workers. This further complicates the problem of determining the most rational forest policy or policies. At the same time, owing to the ravages of war, construction demands for wood and timber have risen enormously.

Forest politics must also take into account the difference between workers who can easily be moved from a labor-surplus area to a labor-shortage area and workers, such as the many smallholders, who are linked to their holdings by strong ties of hereditary ownership and tradition. In many countries, e.g. Finland, Norway, and Sweden, it is of fundamental significance to production that these workers should be employed in forestry in the periods, often of considerable length, when they are not needed for agricultural work. From the point of view of the community, such supplementary employment is worth while even if its utility is less than its cost, whereas the full-time employment of workers transferred into forestry must show a marginal utility comparable to the marginal utility of their industrial employment.

A linking together of small forest properties with small holdings of agricultural land might prove of great value. Such a combination of agriculture and forestry, however, would require further legislative measures to prevent devastation of the small forest holdings and also a system of indirect subvention, through free advice from trained foresters on forest management, with sustained yield as the goal.

Where the forests have been devastated, reforestation will have to be a national or municipal enterprise. The expenditure on capital goods necessary for reestablishing forests in devastated areas is small; it is a question of some hand-tools, plows, and harrows. The price of these things is trivial when compared with the expenditure on wages for the workers. For the private owner this expenditure is a genuine cost as it diminishes his individual share of the current total revenue. But to the community it is not necessarily a cost because current total revenue is not diminished when spare workers, who must otherwise be maintained in idleness, are employed in planting

forests; on the contrary, future total revenue will be augmented by such a measure.

France has given the outstanding example of the wisdom of such measures. Under an act of 19 July 1857, the county councils of southwestern France, between the Garonne and the Pyrenees in the swampy and deserted region called Les Landes, were obliged to drain the soil and plant forests. If they did not do it themselves, the state would do it. But the state would then, of course, be entitled to take all future income until all expenses, including the total amount of interest, had been repaid. Within a period of only 20 years, 600,000 hectares were drained and reforested, and today the forests of Les Landes cover about 900,000 hectares, or 80 percent of the total area. From being one of the poorest parts of France with a small and unhealthy population, this province became within 50 years one of the most prosperous.

It has been the purpose of this article to show that the urgent problems of forest politics cannot be solved by more or less emotionally dictated measures, as has hitherto been the approach to them in most of Europe; they must first be put on the solid basis of rational economic analysis.

The Forester and Nature

By JEAN E. GOBERT

THIS article can be only a brief introduction to the study of nature preservation.

The organization and functions of the services concerned with this subject vary from country to country. Consequently, the problems connected with preserving the beauty of the countryside and its wild life are solved in different ways. It may prove interesting to the reader to see how the general observations set down here apply to the particular conditions in his own country.

Various Aspects of Interest in Nature

Love of nature is a very old sentiment. It has grown stronger as man has become more and more bound by the exigencies of urban life. The increasingly artificial character of such an existence, and the restraints and obligations of life in common, make man more and more desirous of finding freedom in the heart of nature, though this may be only an illusion of liberty.[1]

This desire to escape and return to nature is certainly not new. In modern man, however, it has taken aesthetic forms in which his ancestors surely had the feeblest interest. They were too close to nature to assume a contemplative attitude toward it and still less to consider it from the point of view of beauty.

Further, the development of tourism has given to the preservation of the countryside and its wild life a commercial interest it never had in the past. As a result, a number of countries have enacted special legislation.

What Should Be Protected?

From these very general observations, it becomes obvious that the problem of the preservation of nature can be approached in various ways: protection of certain stretches of countryside because of their picturesque, sentimental, historic, or artistic interest; complete protection of vestiges of primitive nature (sites, animals, plants) with a view to scientific study; protection limited to certain natural associations of trees or plants or of certain rare and precious plants; or protection of animal species threatened with extinction and of importance to biologists or hunters (the bison of America and Europe; Alpine ibex; African game; whales, seals; rare birds).

The possible viewpoints therefore vary according to the person, the place, and the period.

The hunting of beaver was forbidden in Poland in 1000 A.D. About the year 1423 royal Polish edicts prohibited the hunting of deer, boar, wild horse, and elk (moose), and the felling of yew trees. In the limited form of game protection in the royal hunting preserves, old French laws made a first contribution towards conservation. And it was the needs of the French Royal Navy that caused Colbert to promulgate a series of measures to preserve and improve the forests of France.

The first *séries artistiques* — parts of forests preserved for their artistic interest—were initiated in 1861 in the Forest of Fontainebleau, in response to the wishes of artists. This was, if not the first, at least one of the first institutions which were, a little later, developed on a more grandiose scale in the national parks of various countries, notably in the United States of America.

The first "strict natural reserves" appear to be those established by French authorities on Madagascar as early as 1927. These reserves were instituted for the complete protection and study of uninhabited parts of the territory, which possess unique species of plants and animals of great interest to science, but they are threatened by numerous dangers and misuses. Supervision and management were entrusted to the Forestry Service, while the Museum of Natural

[1] See F. Paulhan, *L'Esthétique du Paysage*, and J. de Gaultier, *La Vie mystique de la Nature*.

History in Paris carried out the organization of research work.

Similarly inspired was the institution of the Parc National Albert in the Belgian Congo in 1925, which is a model of its kind. There are numerous examples of such parks established in various countries since the beginning of the twentieth century.

It is now necessary to define carefully the expressions that should be used in order to avoid a confusion of language and ideas, and to describe the exact character of the various types of protection.[2]

Precise definitions of the terms "national park" and "strict natural reserve" were adopted at the International Conference for the protection of the Fauna and Flora of Africa, held at London in 1933:[3]

> Article 2.
>
> The expression "national park" shall denote an area (a) placed under public control, the boundaries of which shall not be altered or any portion be capable of alienation except by the competent legislative authority; (b) set aside for the propagation, protection and preservation of wild animal life and wild vegetation and for the preservation of objects of aesthetic, geological, prehistoric, historic, historical, archaeological or other scientific interest for the benefit, advantage and enjoyment of the general public; (c) in which the hunting, killing, or capturing of fauna and the destruction or collection of flora is prohibited except by or under the direction or control of the park authorities.
>
> In accordance with the above provisions, facilities shall so far as possible be given to the general public for observing the fauna and flora in national parks.

The definition of "strict natural reserve" was inspired by Article 4 of the decree establishing the reserves in Madagascar:

> . . . an area placed under public control, throughout which any form of hunting or fishing; any undertakings connected with forestry, agriculture or mining, any excavating or prospecting; drilling, levelling of the ground, or construction, any work involving the alteration of the configuration of the soil or the character of the vegetation; any action likely to harm or disturb the fauna or flora, and the introduction of any species of fauna and flora, indigenous or imported, wild or domesticated, shall be strictly forbidden; which it shall be forbidden to enter, traverse or camp in, without a special written permit from the competent authorities, and in which scientific investigations may only be undertaken by permission of those authorities.

It is important to distinguish clearly between these two main categories and to avoid using one term for the other.

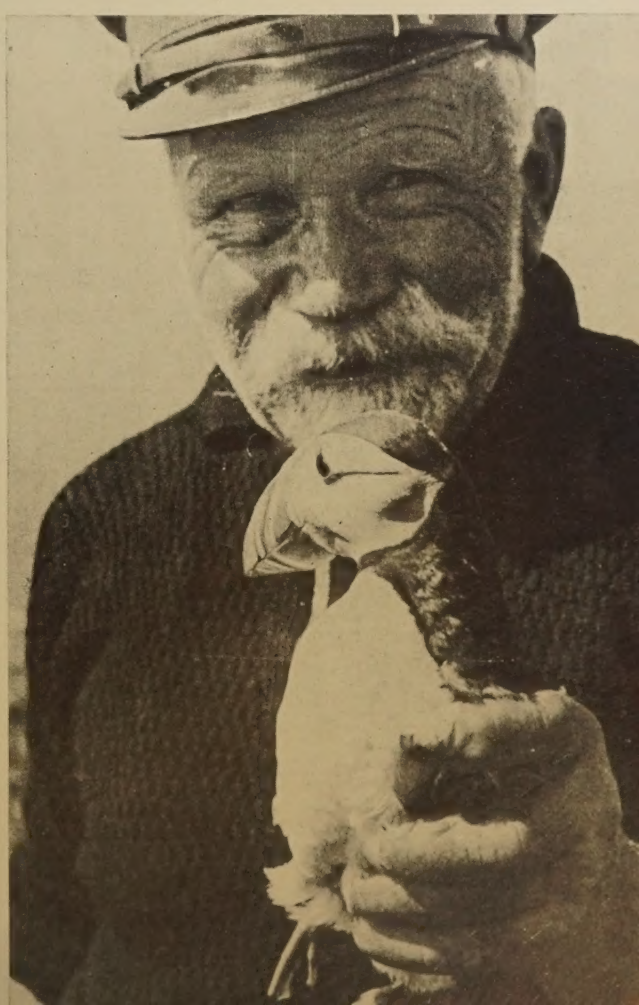
Of course, the preservation of certain species or natural formations can also be envisaged in a more limited way in certain cases. This might be necessary, particularly in highly civilized countries, where the carrying out of major projects such as those outlined above would encounter tremendous difficulties.

Thus, devastated forests of the Mediterranean area could be kept as reservations and protected from ordinary exploitation, with a view to their reconstitution by appropriate and progressive steps. This obviously entails more or less extensive action, but the constitution of a strict reserve is more often than not impossible and inadvisable. Those in the Mediterranean area would be *reserves for reafforestation.*

As we have seen, *séries artistiques* have been arranged in certain French forests—Fontainebleau and La Grande Chartreuse. The public is admitted and necessary steps are taken to preserve the æsthetic character of the forests. Moreover, they can have a dual purpose, artistic and biological.

Limited *botanical reserves* may also be instituted to protect an area having particularly interesting vegetation. In this category is the small preserve of Saint-Crépin in France, in the Département des Hautes Alpes, established to protect an extremely interesting colony of *Juniperus thurifera* which is truly a relic; its equivalent is found only in North Africa. In the United States of America certain national parks are really botanical preserves to safeguard the famous Sequoias.

The purely *zoological reserves* are often thought of only as hunting preserves. The French Forestry Service purposely closes certain forests to hunting during one or several periods of nine years. The idea has been applied on a very large scale in certain parks and reservations in the United States of America, Canada,



The warden of a sanctuary on the Atlantic Coast of France, holding a puffin.

[2] On these questions, see in particular Société de biogéographie, *Contribution à l'étude des réserves naturelles et des parcs nationaux*, Paris, 1937. Reference to the following records will also prove useful: Société d'Acclimatation, *Compte rendu du 1er Congres international pour la protection de la Nature*, Paris, 1923. Société d'éditions géographiques maritimes et coloniales, *Compte rendu du 2ème Congrès international pour la protection de la Nature*, Paris, 1932.

[3] Agreements concluded at the International Conference for the Protection of the Fauna and Flora of Africa, London, 1933.

and the British possessions in Africa.

There is also the *geologic or prehistoric reserve* designed to prevent vandalism and exploitation in mineral deposits, interesting caves, fossil beds, and other prehistoric remains.

Legislative and Administrative Aspects

In Canada, the scanty population and the primordial state of nature over immense stretches of territory, together with the severity of the climate—which gives automatic protection during a great part of the year—were among the factors that facilitated the establishment of national or provincial parks and zoological preserves, bird sanctuaries for example.

Hardly anywhere else can such plans be realized without clashing with custom or vested interests. It has therefore been necessary to have recourse to legislation and regulation, based upon a detailed study of the needs of the population and its industries, including tourism—and upon precise aims.

In the United States of America, the act of 1872, which established the Yellowstone National Park, clearly sets forth a twofold purpose:

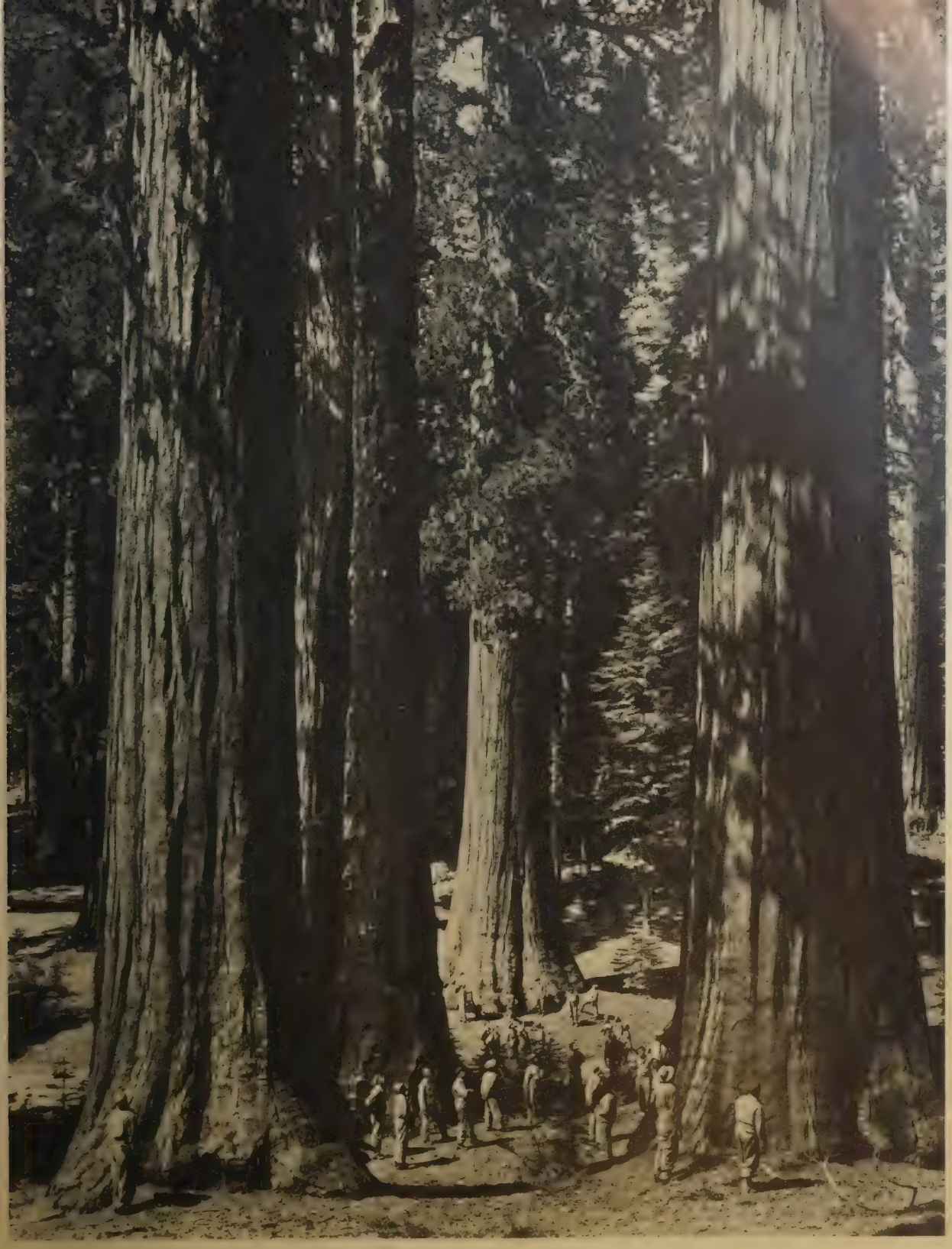
> Such regulations shall provide for the preservation, from injury and spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition. . . . [The park is] dedicated and set apart as a public park or pleasure ground for the benefit and enjoyment of the people.

The law gives a large place to tourism, and experience has already shown that it is perhaps too generous in this respect. For example, to profit from a source of warm water, an institute of hydrotherapy has been built in the middle of an upper geyser basin. This cannot help being a disadvantage from the aesthetic point of view on a site that is unique in the world.

In addition, the influx of visitors affects the animal population, either by frightening away certain animals in spite of the precautions taken to limit the human invasion, or, on the contrary, by modifying the character of the animals and making them excessively familiar. This is the case with the black bears, which, in the Yellowstone as in various other parks of the United States and Canada, come to beg for scraps brought by the visitors. They also scavenge food from the refuse of camps and hotels. Measures have already been taken to avoid the harm that might result from this, particularly the resultant degeneration of these animals, which by nature are rather misanthropic.

The flow of tourists is also regulated to avoid damage to the forests, but certain unforeseen injury can occur. The redwoods, *Sequoia gigantea*, of the Sequoia National Park and of the Yosemite National Park have been seriously threatened with destruction

Rundle Mountain in Banff National Park, Canada.



Giant redwoods, Sequoia gigantea, *in Yosemite National Park, U.S.A.*

The bears are becoming excessively familiar in Yellowstone National Park, U.S.A.

by the tramping of campers and tourists. This destroys the mycorrhiza by means of which these giant trees, like many others of more modest proportions, draw their nourishment from the soil. These colossal trees, which reach a height of 200 feet (61 meters) and sometimes even 300 feet (100 meters), were about to be killed by people walking on the earth, although they had successfully resisted all other causes of destruction for thousands of years. Urgent measures have been taken to remedy the situation.

We find here, in unexpected form, the same harmful effects on the preservation and generation of trees as results from the crowds of pedestrians in the Bois de Boulogne and the Bois de Vincennes at the gates of Paris.

Generally speaking, national legislation is necessary to create national parks and strict nature reserves. Such laws and regulations are necessary, but in this field they should be enacted only after extensive study of conditions and consultation with the best available experts. Only legislation, with the authority of government to back it, can oppose encroachments and abuses. And it can provide continuity, which is essential especially in strict reserves with largely scientific objectives.

After laws are passed, administration must settle the details: financial organization, mapping and exact delimitation of the territory, rules for the admission and supervision of scientists and the public, research programs, eventual thinning out of animals too numerous for the equilibrium of the whole group, and so on.

The aims pursued must first of all be clearly established. It is essential to refer to the international definitions quoted above so as to avoid any vagueness in the designation of major establishments (national parks, reserves, sanctuaries) and to determine the appropriate means of action.

The vast national parks of the United States and Canada and the Parc National Albert in the Belgian Congo have necessitated the creation of an entirely new kind of administration. Those of Canada, for example, have central administration in the Department of Internal Affairs at Ottawa, and each of them has an individual local administration.

The national parks and monuments of the United States of America are managed by the National Park Service of the Department of the Interior; the national forests, however, are under the supervision of the U. S. Forest Service of the Department of Agriculture. As to the Parc National Albert,[4] which has a specific scientific objective, it has been managed since 1934 by the Institute of National Parks of the Belgian Congo, endowed with legal entity and administered by a Commission and a Board of Management. The Belgian scientific institutions and establishments are well represented on the Commission and—an innovation worthy of praise—one-third of the members are chosen from among the most eminent members of foreign learned societies. In this way, the universal character of this institution is very strongly marked. King Albert I had fully realized how important this would be. Lovers of nature will always remember him with gratitude.

In addition to the Commissions and the Board, which are responsible for the over-all management and direct the scientific research in this enormous domain, there is a permanent resident staff. Its personnel includes white wardens, *conservateurs*, former officials or officers having wide experience in colonial affairs, and a corps of native guards under their orders to enforce the regulations and to co-operate in all kinds of research work.

It is not possible in this very general summary to go into further details on legislation and administration. That subject merits special study, showing what has been done and the possibilities for the future in various parts of the world. A few more words, however, must be said on one particular aspect of the question.

To preserve the remains of primordial or almost primordial nature, or certain of its features, is certainly worth while, and is still possible in some regions. However, in old countries such as France, where primordial nature has practically ceased to exist, the possibility of more or less complete protection of certain areas in the interest of science is obviously very limited. On the other hand, landscapes rich in history or legend, or having a real artistic or picturesque interest, are relatively plentiful. Legislation has been enacted, notably in 1906 and again in 1930, to protect these natural monuments and sites, though they are generally very far from being in a state of nature. They are protected against all causes of destruction, disfigurement, and particularly industrial interference (erection of factories and high-tension towers, quarries, etc.), against bill-posting, and even against an excess of tourists. Promoters and tourists,

[4]This park extends over an area of nearly a million hectares (2.5 million acres) of equatorial plains and high mountains, of which a great part is a strict reserve, exceptionally rich and varied from a botanical, zoological, and geological point of view.

by ill-advised or excessive publicity, often risk destroying the object of their profit and admiration.

The public will have to be educated on these matters, in certain countries particularly, and the instruction should begin at school. But that is another story, which is mentioned only in passing.

The Contribution of Foresters

It is obvious that in the great work of conservation, first begun at the end of the last century, foresters must play an essential part. Wherever parks or reservations exist or are possible, foresters must take part in scientific research on forests and their evolution. That entity, the forest, is quite another thing than the sum of its trees. Scientific study of forests still in their primordial state holds interesting discoveries in store for us in the evolution of forest soils, natural regeneration of tree species, their alternation, the laws of growth of individual trees and stands, and so on. All of these things show a fascinating diversity according to the types of stands and climatic conditions suitable to the existence of forests.

Even apart from their particular field of study, foresters of all countries will always find it reciprocally profitable to collaborate with scientists in all branches of research.

It seems certain, for instance, that in those coniferous forests of Europe still in a virgin state (certain forests of the Carpathians, and the Swiss National Park), just as in the equatorial forests, leaf-eating (phyllophagous) and wood-boring (xylophagous) insects never develop to the degree of destructiveness that they unfortunately achieve in a more or less artificial forest. An equilibrium exists among the environment, the trees, their parasites, and the parasites' parasites; there is no serious menace to the trees so long as this balance is not destroyed by man.

It would be interesting for foresters to carry out research in this direction in collaboration with qualified entomologists. The example of A. Barbey of the Swiss National Parks has proved that certain foresters are perfectly qualified to do research on biological questions while at the same time carrying out their practical applications. It is to be hoped that this example will be followed by many others.

Foresters are usually well acquainted with wild life and can add valuable observations to those of specialized zoologists. They can also point the way to research in some particular direction, such as work on freshwater fauna and fish-life.

Their administrative experience can be as valuable as their specialized technical training. In this sphere the aims pursued, whether scientific, aesthetic, or tourist, can be attained only by legislative and administrative measures that have been carefully studied and adapted to varied circumstances. In France, for example, forestry officials manage the forests of the state and of the communities, and consideration is being given to extending their duties still more. In the course of centuries, men of this profession were jurists who became sylviculturists or forest technicians. During the nineteenth century they took over management and reafforestation. Then they had to study wood technology, and—especially since 1939—economic questions. In the mountains they carry out the important work of restoration and reafforestation linked with torrent control. Their administrative and technical experience therefore has been both important and diversified.

Even while they are striving to reconcile good forest management with the exceptional timber needs of the present day, foresters can perhaps still find time for the study of aesthetic and scientific questions. In many countries they will be able to do something personally, either in their administrative capacity or through their own research work. Others can give valuable help to scientists or stimulate their interest.

It has been possible in this rapid sketch to touch only the most interesting aspects of the problem. It will be worth while to round out the picture little by little in a series of more special studies. For example, each country could profitably study the question in relation with its own forests and foresters, as well as with hunting, fishing, and tourism.

The great idea of nature protection has, as King Albert I of Belgium sensed it, an international bearing. It should be, it must be, a means of public education in all countries. It must be used as an instrument for the preservation of the natural beauties and natural riches for which we are accountable to generations to come. It has, therefore, a definite place in the program of those organizations now paving the way to genuine international co-operation.

This article was prepared in the French language and translated by FAO.

Accompanying photographs are reproduced by courtesy of the author, the Canadian National Parks Bureau, and the National Park Service, U. S. Department of the Interior.

Ailefroide Massif, Pelour National Park, France.

Woodworkers and World Forestry

By ELLERY FOSTER

Key men in the timber industry, at work in a ponderosa pine logging operation, Idaho, U.S.A.

WHY a world which develops airplanes, atom bombs, and all kinds of destructive gadgets to a high state of technical perfection should keep on mistreating or neglecting most of its soils and forests is one of the exasperating paradoxes of history. The soils and the forests produce what the world's people need most in the way of material things: food, fiber, and building materials. Yet, we keep on mismanaging the soils and the forests. So the people keep on being hungry, poorly clothed, and ill-housed, and they keep on going to war, foolishly hoping in that way to end their poverty.

There is no sense in this situation, as anyone can see. More and more people are waking up to it. One group already awake to it is the International Woodworkers of America, an affiliate of the Congress of Industrial Organizations. The IWA is the principal labor union of logging, sawmill, and related wood-industries workers in the United States and Canada. They are to "basic wood" what the CIO Steelworkers are to basic steel. They are not as large and powerful a union as the Steelworkers, because American wood is harder to organize than steel, which is preponderantly in large operations. Wood is made up chiefly of many small operations, far flung through the forests from Florida to Alaska. But the 75,000 organized woodworkers have a forestry program, and are proud of it. To report why IWA has a forestry program, what the program is, what's been done about it, and to suggest what it may mean to world forestry is the purpose of this article.

Why Woodworkers Are Interested in Forestry

It wasn't a desire to be "do-gooders" for the world that led American woodworkers to take an interest in forestry. Quite the opposite. If the world had managed its forests properly the woodworkers would not have to spend time and money in publicity and lobbying for a forestry program. But woodworkers have always had to fight to improve their conditions. A generation ago IWW (International Workers of the World) loggers waged a bitter struggle to get the camps deloused, sheets on the beds, single beds instead of double-decker bunks, better food, and shower baths. They accomplished a good deal.

Even with the improvements won by the "Wobblies" the camps were still camps, and a poor substitute for a permanent community where a logger could live with his family and count on sustained yield forestry to keep a supply of timber near by as long as he wanted to work in it.

Sawmill workers also had a grievance against the old ways of cutting timber, which forced them to follow a migrating industry. A man wants a job in a community which has a future. Then he can invest confidently in a home of his own. His investment will be worth something. But if the town is going to become another ghost town, a house and lot is a poor investment.

Woodworkers began to get acquainted with foresters. They learned that forests can be managed, like some of those in Europe and elsewhere, to produce a steady supply of logs every year forever. With modern transportation, that means the opportunity for both woods and mill workers to live at home in good permanent communities, with dependable jobs.

Then there is the problem of productivity, which is the long-range key to higher wages and shorter hours for labor. Woodworkers observed that many of the small logging outfits and small sawmills which get out most of the logs and lumber in America are very inefficient and very wasteful. The problem is being aggravated as the forests "wear out" and the logs become smaller and smaller. Productivity is less with smaller logs. Yet numerous efficient operations proved that a much better job could be done.

The industry has other problems that make life hard and uncertain for woodworkers. Historically, lumber in America has been a "feast-or-famine" industry. Lumber prices skyrocket like almost no other commodity in boom times. They can hit the skids, too, and production can go down to where there is only a couple of days' work a week or none at all, when the lumber market is poor.

On top of all this, the long-time trend of American lumber for nearly 40 years has been down. A declining industry is not a good one to work in. But the woodworkers found that the industry need not decline. Instead it could and should be a steadily expanding industry.

Besides all this, woodworkers see forestry as an important part of the world's agriculture. They see agriculture as the basic key to freedom from the want which breeds war. Therefore, woodworkers believe that striving for ample production of wood to help

meet the world's housing and other wants is one practical thing they themselves can and should do to help save themselves from the terror of another war. That is because wood is their specialty. Knowing something about it, they can be more effective in this phase of the world's peace efforts than in other phases which they know less about.

The answer to all these problems, of course, is a broad-scale forestry program. Through talks with their forester friends the woodworkers decided to go in for a forestry program, and use such influence as they had to get it going. They went into forestry out of self-interest, but it is one of those happy instances where the self-interest of a group coincides exactly with the public interest. That will become clear as we see what the woodworkers advocate in the way of a forestry program.

The IWA Forestry Program

Stated briefly, what both the IWA and the national CIO recommend in forestry is essentially the same sort of program as the United States national farm program. That, of course, is a comprehensive program of technical and economic assistance to the operators.

Specifically, the major IWA-CIO forestry recommendations call for the following:

1. The services of forestry experts to assist forest owners and operators in the use of scientific methods of tree-growing, selective logging, wood utilization, and marketing.
2. Credit and crop-insurance aids similar to those of the American farm program.
3. Forest conservation benefit payments (subsidies) for tree-planting, timber-stand improvement, and other forest-conservation measures similar to the soil-conservation payments now widely made to American farmers. The woodworkers believe more forestry can be bought with a dollar of government money, through subsidies, than through public ownership. That is because the individual has an incentive to improve his own property which he doesn't have when employed to improve government property.
4. A vast system of permanent logging roads, similar to our present system of farm-to-market roads.
5. Greatly improved protection of forests from fire, insects, and disease.
6. Government aid in developing plants to make building materials—such as fiberboard, plastics, built-up lumber, and other useful products from wood that is now wasted.
7. Finally, a federal law making it illegal to cut timber for commercial purposes until a trained forester—either licensed by or directly employed by the government—has assisted the operator in developing a specific cutting plan designed to keep the forest producing.

Some people may wonder why American woodworkers put so much emphasis on government assistance to the owning and employing class. This may be especially true of those who are conditioned to think that labor unions are opposed to private property, and also those who think of lumbering in terms of giant corporations or lumber barons who need no assistance, but who do need to be sharply regulated if our forests are to be managed for community sustained yield.

The mill goes to the woods. Portable sawmill in western Canada.

The answer is, first, that the woodworkers pride themselves on being practical. What they are after is better conditions of life for themselves and their families. Many of them have seen that the government farm program did get results in soil conservation, increased food production, and more stability and security for farming. They have found that, contrary to popular belief, the greater part of the ownership of American forests, of logging and of sawmilling, is small-scale business. Many of the owners and operators will never do a really efficient job unless they get technical assistance, and financial aid as well. They are like the farmer who couldn't get on a good soil-conservation basis until he got out from under a usurious mortgage that forced him to plant every acre to soil-exhausting row crops each year in order to pay the interest.

When the woodworkers recommend government forestry aids to the landowning and employing class, they are not doing it out of altruism. They are doing it because it looks like the only practical way to get good scientific management, as soon as possible, on the bulk of American forest lands and in the bulk of logging and sawmilling operations. Woodworkers see scientific forestry as their only escape from the evils of a grossly destructive, wasteful, inefficient, and migrant industry.

The woodworkers know that there are many differences of opinion to be ironed out before anything fundamental can be done about the broad problem of concentrated property, which has long been America's Number One problem. In the meantime they see that property is not as excessively concentrated in their industry as in most. They believe that their proposal of government assistance to more than 4 million forest owners and operators in the United States alone — with an additional large number in Canada—should not meet with serious opposition. They know that some lumbermen will fight against government regulation of tree-cutting, but they believe that the weight of the CIO, added to that of other groups that have long deplored the recklessness with which we permit our forests to be destroyed, may turn the tables in the long struggle to curb needlessly destructive logging.

Logs and machines. Skidding logs by tractor in British Columbia.

With a program such as they recommend, the woodworkers visualize the future American wood industry as based chiefly on a large number of small forest holdings, each managed by an operator who has learned to be a successful and efficient "dirt forester." In large part this tree-growing would be an adjunct of farming, and an integral part of American agriculture. Since many American woodworkers already are "stump ranchers," some would become "dirt foresters" themselves, helping to produce trees for logging and manufacture.

With appropriate government assistance, we believe a more intensive brand of forestry will be practiced on small individual holdings than in large corporation forests. Prevailing methods on the latter are of an "extensive" type, which fails to achieve the full potentialities of the soil.

With the many small and medium holdings placed under scientific management, there should be a steady flow of logs coming out of the forests each year into each woodworking community. The wood-using industry can then adjust itself to handle the yearly log crop, as the food-processing industry is adjusted to handle the yearly food crop. That way the industry will be stabilized. Through collective bargaining, our next aim would be to adjust the operations to provide steady employment as nearly as possible throughout the year.

It is obvious that this program will cost money. Like the farm program, however, this one should produce benefits far in excess of its costs. The woodworkers hope the national concern over the lumber shortage and the shrinking of national and world timber supplies will help to convince even those members of Congress justifiably anxious about our national economy of the urgent need for a practical program to speed forest growth and to use more of the wood in each tree that is harvested. When they become convinced of that, our program makes sense.

The Time for Action

A few additional words of explanation may be in order as to why we believe such a program should be undertaken at the present time. The essence of it is that we are at the most important change-over point in the history of American forest industries. Up to now we have been relying almost wholly on wild crops of trees. The prevailing policy has been and still is to take any tree the operator thinks he can make a profit on, and not worry about future crops of trees. We have relied on private initiative to convert those wild crops into lumber and other wood products. Most logging and sawmilling can be greatly improved, as much of our farming was after the county-agent system began getting scientific know-how to the farms. With the old methods we see our forests growing less than half as much timber as they might grow. And our wood industries are using only about one-third of the wood in the average tree which they harvest.

The time for transition in American forestry—from merely harvesting the wild crop to scientific

forest management—comes, moreover, at a time when our agriculture is urgently in need of a new frontier such as scientific forestry can provide. Machines are crowding people off the land by making it possible for one man to handle more and more crop land and livestock.

Practical dirt forestry can provide new opportunities for people who prefer to work with growing things. It can provide such opportunities, however, only if such people have a chance to learn the special skills of forestry. Because we have relied so much on wild timber growth up to now, only a few of our 4½ million forest owners know anything about forestry. Until the government provides technical assistance to them, we can expect little progress in forestry on the 70 percent of our private forest land that is owned in small tracts. Indeed, many of these tracts are being clear-cut or highgraded right now, because we lack such a program.

In the same way, we cannot get efficiency in the bulk of logging and sawmilling until the government provides the assistance of production and marketing experts such as it now provides to farmers.

The choice before us is, Shall we let things drift, or shall we tackle the job with realism and determination? If we let things drift, we shall see some of the industrial forests managed scientifically, and a few of the small tracts. On the whole, however, we shall still be wearing out our forests and wasting our timber. As the total forest resource shrinks, we shall see large industrial forest owners tighten their grip on our timber economy all the way from the stump to the retail lumberyard.

On the other hand, if we undertake a sensible program, we can get increased production for today (through improved timber utilization and greater efficiency of production) and at the same time build up our forests for future harvests (through selective logging, planting, and better protection). In that way we can also get the other benefits of forestry, including stable communities, watershed protection, wildlife, and forest recreation.

What the Woodworkers Have Already Done

The woodworkers have been trying to get the public and the government to understand the problem and to see that the welfare of whole communities and the public interest are at stake, as well as the jobs, security, and living standards of woodworkers. A forestry resolution introduced by the woodworkers was adopted by the CIO national convention at Chicago in 1944. Since then the national CIO has actively helped to wake up the country to the needs of a practical program of government assistance to the small forest owners and operators.

The IWA international convention in November 1945 adopted a series of resolutions amounting to a comprehensive postwar forestry program. These were printed in a folder entitled *A Forestry and Wood Utilization Plan for America*. Also included in this folder was a statement by the international officers, saying in part, "Our fight for good wages, hours, and conditions can meet with only partial and temporary success if we merely bargain with our employer over the spoils of an industry which destroys the forests and wastes more of the crop than it uses."

Early in 1946 the IWA prepared an analysis of the lumber situation, entitled *Lumber Snafu*, which was widely distributed, reprinted in the *Congressional Record* (13 April 1946) and the *Journal of Forestry* (June 1946), and received much favorable comment. It called for a unified wood-production and forest-conservation program, as recommended by the 1945 convention and described herein.

Then in September 1946, the national CIO got out the pamphlet, *America's Logjam and How to Break It*,[1] which tells in more detail and in more popular style essentially the same story as *Lumber Snafu*. It has had still wider distribution and a great deal of favorable comment.

IWA and CIO spokesmen appeared at the American Forestry Congress[2] in October 1946 and pleaded with government and industry representatives for a practical, effective forestry program. They supported a comprehensive forestry bill introduced in the 1946 Congress by Frank E. Hook of Michigan. Hook was defeated by a narrow margin in the 1946 election, and as yet the Congress has not come to grips with the problem.

The national CIO convention in November 1946 again adopted an IWA resolution, calling for a program such as that outlined herein.

Consistently, for more than a year, the weekly *International Woodworker*, official paper of the IWA, has devoted a substantial amount of space to the pro-

[1]CIO, 718 Jackson Place, N. W., Washington, D. C., or IWA CIO, 314 S. W. 9th Ave., Portland 5, Oregon.

[2]American Forestry Association, 919 17th Street, N. W., Washington 6, D. C.

Home in the Forest I: Old-style portable shacks in Montana, U.S.A., hauled to a clear-cutting operation on railroad cars.

duction and conservation problems of the wood industry. This material, too, has stimulated interest in the subject.

Thus far, however, the results of the IWA-CIO efforts are merely increased conversation about forests rather than better conservation of them.

The woodworkers believe that there has been about enough talk on the subject. They believe it is time for action. They are keeping up their efforts to get such action.

World Aspects

We believe that the IWA-CIO forestry program puts these labor organizations squarely on the side of the FAO in the fight to conquer the world's wood shortage. We believe that America could export huge amounts of valuable building materials to help meet world needs if our governments would only help to finance new plants to utilize waste wood, as they helped finance plants to make fighting planes, ships, and other war materials. We have the raw material and the technical know-how, but market uncertainties make private capital hesitant to assume the entire risk. Yet the need for the products exists. With the help of our national governments and the UN it should be possible to get the production and then get the products to where they are needed.

But we have a bigger dream than that of American forestry and American forest exports alone. Trade departments are now being organized within the World Federation of Trade Unions, with which the IWA is affiliated through the CIO. The IWA will be directly affiliated with one of the WFTU trade departments, where logging and sawmilling workers from all over the world will be able to get together and hammer out programs dealing with the common problems of woodworkers everywhere.

Out of the woodworkers' department of WFTU we hope to see emerge a world campaign to get scientific management into the woods everywhere, so that all woodworkers can enjoy the benefits of dependable, productive jobs in good stable communities based on sustained-yield forest management.

We, of course, don't know what specifically will be included in the forestry program of the woodworkers' department of WFTU. But it is easy to guess that it will encompass some big and exciting things, such as the development of sustained-yield communities in the world's hitherto mistreated or neglected forests and a better system of transportation and trade to get wood from nations where it is to nations where it is needed.

Just as American woodworkers are today helping to publicize and to press for action on the American forestry problem, the world's woodworkers, before long, may be performing the same kind of service for world forestry. They have good reasons for doing it in their own self-interest. It is a must if there are to be greater security and better conditions for woodworkers. Yet what will serve the woodworkers' needs in those respects will also serve the world's needs for wood and for all the public benefits which can come from well-managed forests. And so we believe that, in a world of conflicting political ideologies, the woodworkers' interest in improving their own conditions of life and work provides a valuable common denominator for the forestry work of all the nations. By keeping the interests of woodworkers clearly in mind, we believe, the Forestry Division of FAO and the forest services of individual nations — will find their own tasks simpler and their goals more attainable.

Photographs accompanying this article are reproduced by courtesy of the Canadian National Parks Bureau, Dominion of Canada Forest Service, and the Forest Service, U. S. Department of Agriculture.

Home in the Forest II: This planned community, with family houses and bachelor quarters, is built on a selective logging operation in the State of Washington, U.S.A

The Position of Cellulose as a Fiber-Forming Polymer

By HERMAN MARK

THE purpose of this article is:

(1) to review briefly the outstanding properties and production possibilities of a number of new fully synthetic fibers;

(2) to compare them with synthetic fibers based on cellulose; and

(3) to attempt an outline of the advances cellulose chemistry and technology will have to achieve if fibers based on this material are to compete successfully with the new products to be considered under (1) below.

(1) Brief review of fully synthetic fibers.

During the last twenty years chemical industry has started producing a number of highpolymeric substances which have proved very suitable for processing into fibers and films. These highpolymers are being made from coal, oil, air, and other basic raw materials by means of a two-step process. First, from the basic raw materials are produced low molecular weight intermediates, the so-called basic units or monomers. From them the polymers are then built up by a process of polymerization, which unites the small basic units having molecular weights around one hundred by strong chemical bonds to form large molecules having molecular weights of several hundred thousands and, in most cases, possessing the character of a long flexible chain. The art of polymerization has been greatly developed during the last 10 or 15 years and there can be little doubt that it will further develop in the near future. Many leading chemists in all countries feel themselves attracted by the peculiar nature of the polymerization reactions, and extensive research is being done in this field in many universities and public research institutions. It is significant for the general interest shown that many seminars, symposia, and special conferences are being held every year to discuss problems of polymer production, characterization, and utilization. A special Institute of Polymer Research has been created at the Polytechnic Institute of Brooklyn, and a Journal of Polymer Science has been published in the United States of America since 1946. This public interest is stressed by intensive research work in many industrial organizations, and it is probably a conservative estimate to put the total number of highly qualified research chemists, physicists, and engineers specialized in this field at around 5,000 to 6,000. As a consequence of this interest and of the resulting research activities, it seems safe to predict that within a short period:

(a) The price of presently known basic materials, such as dibasic acids, diamines, glycols, vinyl and acrylic derivatives, will gradually decrease and may go down in particularly favorable cases to between \$0.10[1] and \$0.20 per pound (1 lb. = 0.4536 kg.).

(b) The efficiency and economy of polymerization techniques will gradually improve: this is bound to lead to better and cheaper polymers. Again, it seems fair to assume that the cost of the polymerization step may level off at \$0.05 to \$0.10 per lb. of the final polymer, so that in favorable cases the price of fully synthetic fiber formers may reach levels ranging as low as from \$0.15 to \$0.30 per lb.

(c) Entirely new monomers and polymerization processes will be discovered, which will either make possible even cheaper fiber-forming polymers than those mentioned under (b) or will enable us to produce fully synthetic fibers of greatly superior properties which could be used for purposes inaccessible to the present artificial fibers based on cellulose, such as viscose rayon, copperammonia rayon, and cellulose ester rayon.

With this probable development pending in the not too distant future, it is interesting to consider the question: How far will cellulose as a successful competitive polymer for fiber formation be endangered by the synthetic polymers and how can its position be maintained in the future or even improved by active and well co-ordinated research in the cellulose field?

Consideration of this question should start by an enumeration of the fully synthetic fibers, which have been developed recently and are beginning to invade the various branches of the textile industry.

The most important of them is nylon. Nylon is a generic term for a large class of polymeric compounds. The essential discoveries were made by Carothers and his associates in the laboratories of E. I. du Pont de Nemours and Company about twenty years ago.[2] Nylons are produced by combining dibasic acids with diamines or glycols and constitute high-melting substances (melting points around and above 250° C.) of high resistance to the attack of acids, alkalis, and organic solvents. These polymers may be spun into fine filaments or cast into thin films, either from solutions or directly from the melt. Generally they are drawn and twisted after the spinning process to obtain very strong and tough fibers of a pleasant luster that compare favorably with all natural fibers and with all

[1] The currency referred to throughout this report is the U. S. dollar.

[2] W. H. Carothers, *Collected Papers on Highpolymeric Substances*. Edited by H. Mark and G. S. Whitby. New York: Interscience Publishing Company. 1940.

artificial filaments produced from materials based on cellulose and its derivatives. The table shows some figures to outline this situation. To date many hundred different nylons have been synthesized and it has been found that they cover a whole range of fiber formers, out of which it is possible to spin filaments of widely varying properties. Thus research chemists of the du Pont Company[3] and of the Bell Telephone Company[4] have found that filaments and fibers of certain nylon types can be produced having a low initial modulus and a high reversible elongation. In their behavior these samples come very close to natural or synthetic rubbers. On the other hand, it has been possible to produce fibers of great stiffness and high tensile strength by using aromatic dicarboxylic acids[5] in the formation of the polymer.

Other interesting fully synthetic fibers have been produced recently by spinning solutions or melts of polyvinyl derivatives and polyacrylic derivatives, such particularly as polyvinylchloride, polyvinylidene chloride, polyacrylonitrile, and copolymers from them. Fibers and films of these materials have already been produced in commercial quantities and have appeared on the market under the names of Vinyon, Saran, Fiber A, P-C fiber, etc. They also cover a wide range of properties, from soft, pliable, and highly elastic films to rigid, strong, and tough fibers. Most materials are highly resistant against attack by any chemical and some of them exhibit excellent stability against oxidation and sunlight.

The table also contains a few figures comparing representative values of cellulose fibers with those fibers based on polyvinyl and polyacrylic derivatives.

The figures presented in this table and the remarks contained in the preceding paragraphs concerning the general properties of fully synthetic fibers raise the question: What are the fundamental molecular properties of these synthetic fiber-forming polymers responsible for their outstanding mechanical, thermal, and chemical behavior? And, in what respect does cellulose differ from them, if at all?

(2) Molecular structure of fiber-forming polymers and mechanical properties of the fibers made from them.

There are a number of factors characterizing a polymeric material and it may be best to start by listing the most important of them.

First, there is the *molecular weight* of the polymer. Experience has shown that really good mechanical properties can be expected only from polymers of high molecular weight and that, in general, the properties improve, roughly, in proportion to the molecular weight. The molecular weight is also proportional to the length of the chain which each polymer molecule represents; the greater this length, the stronger, generally, the mutual cohesion between adjacent polymer molecules in the fiber and the higher the latter's tensile strength. Our present knowledge of polymerization techniques makes it possible to produce polymers of greatly different molecular weights and, in particular, enables us to synthesize materials having a high average molecular weight.

In the case of cellulose, we use a polymer that occurs in nature with a very high molecular weight and degrade it during the various steps of manufacturing into a mixture of larger and smaller molecules, which is then processed into fibers or films. In order to get the best fiber out of a given polymer, it is essential not only that the average molecular weight be of a certain sufficiently high value, but also that the shape of the molecular weight distribution curve be such that the best possible mechanical properties should result. Preponderant in this respect appears to be the absence of any kind of material of very low molecular weight. There are indications that the molecular weight distribution curves of fully synthetic polymers are more favorable for the development of optimum textile properties than those of the cellulose polymers being used at present for the production of the various types of rayon.

Another important factor for the final properties of fibers or films made from any given polymer is the *chemical character* of the polymer. The long chain molecules or cellulose are linked together by oxygen bridges formed during the growth of the molecule by the elimination of water. These so-called glucosidic bonds are very stable towards all organic solvents, are stable to alkali in the absence of oxygen, but are rather easily attacked by acids. As a consequence, fibers made from cellulose deteriorate rapidly under the influence of weaker acids even, whereas some of the fully synthetic fibers are nearly completely acid-resistant. This property is closely connected with the intrinsic chemical structure of cellulose as a polysaccharide and it seems, therefore, that there is no way to escape the unpleasant consequences of this fact. Recently, however, it has been found that it is possible to stabilize cellulose fibers against acids by impregnating them with small amounts of certain synthetic resins, which penetrate most of the fine cracks and capillaries of the fiber, cover the internal surface with a very thin acid-resistant film, and thereby protect the cellulosic material from hydrolytic deterioration.

Then there is the *internal flexibility* of the long chain molecules of the polymer. Experience has shown that flexible chain molecules can be more easily spun and drawn into fibers and cast into films than the intrinsically stiff molecules of cellulose. Conversely, however, stiff chain molecules produce fibers of a higher initial modulus and a higher ultimate tenacity. The molecules of nylons and polyvinyl derivatives are essentially flexible and this property explains the fact that fibers and films of very high, reversible elasticity are relatively easy to produce from such polymers. On the other hand, the molecules of cellulose, consisting of a chain of consecutive glucose rings, are intrinsically stiff and have a strong tendency to aggregate into lightly packed bundles, the so-called cellulose micells. It is not possible to produce from cellulose, therefore, fibers possessing the rubber character of certain nylons or the high resilience characteristic of wool or of certain fully synthetic fibers made from polyvinyl and polyacrylic derivatives.

The last factor to be discussed is the specific

[3] See lectures given by Dr. Whitbacker at various meetings during 1945 and 1946 of the American Chemical Society and the American Association for Advancement of Science.

[4] See, for example, W. O. Baker and C. S. Fuller, "Macromolecular disorder in linear polyamides. Relations of structure to physical properties of copolyamides," *Journal of American Chemical Society*, *64* (1942) 2399.

[5] See, for example, W. T. Astbury and C. J. Brown, "Structure of Terylene," *Nature* 158 (1946) 871.

molecular attraction between the polymer molecules. This attraction depends upon the nature of functional groups (OH, COOH, Cl, CH_3, CONH) distributed along the chain molecules. It is of great importance for the ultimate mechanical properties of the fibers or films produced from a given polymer. On the one hand, strong lateral attraction between the individual chain molecules is necessary to provide high tensile strength; on the other hand, too much crossbonding is often responsible for brittleness and breakage at low elongation. The chain molecules of cellulose with their large number of closely spaced hydroxyl groups exhibit a rather high degree of lateral cohesion which, together with the intrinsic stiffness of the chains, causes filaments and fibers of cellulose to be relatively stiff and unextensible, though having very desirable properties as far as initial modulus and ultimate tensile strength are concerned.

(3) The position of cellulose as a fiber-forming polymer.

Considering the various points discussed above we may summarize the position of cellulose as follows:

Average molecular weight: initially very large; has to be properly reduced during the various pulping and purification processes without producing too many low molecular weight fractions.

Chemical nature of the bonds keeping the backbone chains together: The glucosidic bond is intrinsically sensitive to acids and alkali in the presence of oxygen. This sensitivity can be reduced by the use of protective resins and by a very tight packing of the chains in the fiber (high degree of orientation of the chain molecules).

Internal flexibility of the chain molecules: The chains of cellulose are less flexible than those of other polymers such as nylon or vinyon. This leads to an intrinsic stiffness of fibers and films made out of cellulose which, to a certain extent, can be counterbalanced by the use of plasticizers.

Chain-to-chain attraction: Cellulose molecules exhibit a very strong chain-to-chain attraction, which leads to a high initial modulus and a high ultimate tensile strength but is responsible at the same time for stiffness and brittleness. Substitution of the hydroxyl groups and the use of plasticizers are means of avoiding brittleness in highly oriented cellulose fibers.

The above outline makes it apparent that cellulose has certain intrinsic advantages as fiber former, such as high molecular weight and strong lateral cohesion, but also that it has certain disadvantages as compared with fully synthetic polymers, namely the weakness of the glucosidic bond and the intrinsic stiffness of the chains.

As far as economic considerations are concerned, cellulose should be able to compete successfully even with the cheaper fully synthetic fiber formers, if one considers that in 1939 a very high-grade wood pulp for rayon production was to be had for $0.04 to $0.05 per lb. and that even now high-grade wood cellulose is marketed at not more than $0.08 to $0.10 per lb.

These comparatively low prices would assure cellulose a strong position as a fiber former if they could be in the future combined with:

(a) *A molecular weight distribution* curve that would exclude the presence of highly degraded constituents.

(b) *The absence of any groups that would weaken* the glucosidic bond beyond its normal sensitivity. Such groups are particularly carboxyl and carbonyl groups attached to the main chains.

(c) *A pretreatment* of the chains that would replace a fraction of the hydroxyl groups by substituents less prone to lateral attraction, acting therefore as an internal plasticizer.

A considerable amount of fundamental and practical research is being carried out in the cellulose-producing industry along the lines mentioned above, aiming at an improved raw material for the rayon and cellophane producers. It seems probable that gradual advance will be made towards a *highly purified, pretreated wood pulp with a modified distribution curve.* Such a material should be capable of maintaining, at least for the immediate future, the position of cellulose as one of the most important fiber formers even in the face of mounting competition from fully synthetic polymers.

Finally, it should be pointed out that in many cases the problem of best quality at cheapest price will not be solved by contrasting the use of cellulose with that of a full synthetic polymer, but by using cellulose *together* with full synthetic polymers such as resins, plasticizers, etc. This combination of the properties inherent in cellulose, a cheap raw material, with those contributed by the somewhat more expensive but more adjustable synthetic polymers has already led to very noticeable results and will, probably, in future dominate more and more the thinking and planning of fiber chemists and technologists.

Some Properties of Fully Synthetic Fibers of the Nylon and Vinyl Type as Compared with Viscose Rayon Fibers Made out of Cellulose.

Property	Viscose Rayon Type Fiber	Nylon Type Fiber	Vinyl or Acrylic Type Fiber
Tensile strength dry	from 1.5 to 5.0 grams per denier	from 1.5 to 8.0 grams per denier	from 1.5 to 5.0 grams per denier
Tensile strength wet	between 30 and 75% of dry strength	almost the same as dry strength	almost the same as dry strength
Elongation to break	from 5 to 25%	from 10 to 200%	from 10 to 200%
Range of elastic recovery	up to 2 or 3%	up to several 100%	up to a few 100%
Resistance against—			
acids	poor	good	excellent
alkalis	moderate	good	excellent
organic solvents	excellent	excellent	depending upon solvent
heat	good	excellent	moderate

Research Work in Forestry and Forest Products in Australia

By G. J. RODGER

RESEARCH in forestry may be said to have been carried out from the earliest days of Australia's settlement, although in the beginning it consisted largely of systematic botanical investigations and experiments in the development of exotic trees.

About 1919 the Commonwealth Institute of Science and Industry formed the Forest Products Laboratory. The activities of this institution, which were confined to chemical investigations, laid the foundation for the establishment of the tannin-extraction industry in Western Australia and of the Australian pulp and paper industry in the eastern states. Much of the work of the original laboratory was done in co-operation with the Western Australia Forests Department; and when in 1926 the Institute of Science and Industry was replaced by the Council for Scientific and Industrial Research, this co-operative work was continued without a break, although there was a lapse of three years before the new CSIR Division of Forest Products was created.

At the eighteenth meeting of the Australian Association for the Advancement of Science, held in Perth, Western Australia, in 1926, the following resolution was passed:

> In the opinion of the Council there is need in every State of Australia for more systematic investigation of those Forestry problems which come under the heads of Silviculture and Forest Management. A central co-ordinating authority is necessary if this work is to be carried out satisfactorily. The Council suggests that the Commonwealth Government having established an Australian Forestry School might with advantage extend the scope of the work by embracing general research into Forestry problems.

It was suggested that experimental stations should be established in the main great forestry divisions of the continent to carry out the research work proposed and that the results obtained should be published for general information.

The Commonwealth Forestry Bureau was established at Canberra in the Australian Capital Territory in 1927, and it was decided that in addition to its other functions the Bureau should undertake responsibility for initiating and carrying out investigation and research in three main divisions of forestry: silviculture, forest management, and forest protection. In 1946 the Forestry Bureau was reconstituted as the Forestry and Timber Bureau, and its research functions were extended to cover the supply, production, distribution, and use of timber.

In addition to the research work of the Forestry and Timber Bureau and the Division of Forest Products, which are institutions of the Commonwealth Government, a considerable amount of research on forestry and forest products has also been undertaken by the forestry departments in the states of the Commonwealth, by semigovernmental bodies such as universities, and by private companies and firms.

The following outline indicates the development of activities and the present organization of the various bodies carrying out forestry and forest products research.

Forestry and Timber Bureau

In 1928 initial steps were taken to institute forestry research under the Commonwealth Forestry Bureau by the appointment of research scholars in silviculture, management, and forest engineering. These research scholars underwent a short course of training at the Australian Forestry School, Canberra, before proceeding abroad for more advanced studies. On the completion of their course abroad they returned to Australia and were engaged in various branches of forestry research work.

The Bureau received parliamentary sanction in 1930 by the Forestry Bureau Act No. 16, under which its functions were set out, including among others, "the establishment of experimental stations for the study of silviculture, forest management and forest protection."

The field research work suffered severely as a result of the depression years. Of the initial staff of four officers, three were lost to other services. For several years the work was carried on with the assistance of the staff of the Australian Forestry School. In 1935 the national recovery made an extension of the work possible and in 1937 a staff of three qualified men and five assistants was engaged on research work. In addition the staff received valuable help from officers of the various state services.

In 1938 a research station was established in the southeast of South Australia, in co-operation with the Woods and Forests Department of that state, to undertake work on problems connected with the forests of the district and to extend the work being carried out at the main research station in the Australian Capital Territory.

In January 1941 a joint arrangement was entered into with the Tasmanian Forestry Department by which the Bureau established a branch of the research organization in Tasmania; but owing to the war the work of this station had to be suspended early in 1942.

Australian School of Forestry, Canberra, A.C.T.

Details of the structure of thin wood sections are enlarged by a projection microscope. Division of Forest Products, CSIR, Melbourne.

and the officer in charge was seconded to the Tasmanian Forestry Department until the cessation of hostilities.

In 1946 the Forestry Bureau was reconstituted as the Forestry and Timber Bureau under a director-general, and its functions were extended to incorporate the timber planning and co-ordinating responsibilities of the wartime organization of Commonwealth Timber Control, which lapsed 31 December 1946.

The functions of the Forestry and Timber Bureau as now constituted are as follows:

1. To advise the Administrations of the Territories on all matters pertaining to the management of forests;
2. To manage forests placed under its control by the Governor-General;
3. To establish experimental stations for the study of silviculture, forest management, and forest protection;
4. To provide educational facilities for the training of professional foresters;
5. To establish and award forestry scholarships;
6. To collect and distribute forestry information;
7. To publish reports and bulletins dealing with forestry;
   (a) To collect statistics and information regarding timber supplies and requirements in Australia, and formulate programs on the supply, production, and distribution of timber in Australia and on the importation into and exportation from Australia of timber;
   (b) To advise the Government of the Commonwealth or any instrumentality of that Government, or, when so requested, the government of any state, or any instrumentality of the government of any state, or any body or person, on matters relating to the supply, production, and distribution of timber in Australia and the importation into and exportation from Australia of timber;
   (c) To carry out investigations and research relating to the supply, production, distribution, and use of timber.

The Forestry and Timber Bureau at present comprises five main divisions: (1) Forestry Education (Australian Forestry School); (2) Forest Research; (3) Forest Resources; (4) Timber Statistics and Planning; and (5) Administration and Management.

The Forest Research Division has its headquarters at Canberra, A.C.T. It has experimental stations in South Australia and Tasmania in co-operation with the respective State Forest Services, and negotiations are in progress for the establishment of experimental stations in other states. The work of this division is to be expanded to cover a wide field of forest research as suitable staff is available.

Division of Forest Products, CSIR

Following the replacement in 1926 of the Institute of Science and Industry by the Council for Scientific and Industrial Research, the Division of Forest Products came into being in 1929.

Before the formation of this Division, two young graduates were selected and sent overseas for training at the United States Forest Products Laboratory. This policy was continued for several years until there was at least one officer soundly trained in each branch of forest products research. The first two of these to return to Australia, together with several officers having forest products research experience in state departments in Australia, formed the original staff of the Division. Owing to lack of central facilities this small staff was at first scattered, one member remaining in Western Australia, one working in Canberra, A.C.T., and the rest in Melbourne, Victoria. Temporary accommodations were gradually developed in outbuildings of an old residence occupied by the CSIR Head Office in East Melbourne and this sufficed until, in 1936, the Division moved to a new laboratory at its present location, 77 Yarra Bank Road, South Melbourne, Victoria.

This was the first Division of the Council for Scien-

tific and Industrial Research to devote its activities to secondary industry. Lacking research facilities in the first instance, much of its initial work consisted of surveying the needs of the Australian timber industry and of conducting an educational campaign throughout the industry along the lines of sound practice in timber seasoning and general factory procedure. As laboratory facilities were gradually acquired, problems peculiar to Australia were investigated and the information gained was passed on to industry. In this way the Division quickly won recognition for its work, and its association with all branches of the timber industry has always been of the happiest nature. Further, liaison has been maintained with state forestry departments and with other Commonwealth departments interested in forestry and forest products. There has been the closest co-operation with those state forestry departments that have forest products branches of their own. In 1946 a conference of all departments interested in forest products research was convened to study means of avoiding duplication of effort and to plan work to the greatest advantage; it is proposed to hold similar conferences annually.

The very considerable development of the Division's research facilities during the 19 years of its existence has been closely linked with practical application of laboratory results, and largely because of this it was able to play a most important part in assisting to solve Australia's timber problems during World War II.

The general organization of the Division of Forest Products is as follows:

Chief of Division

Assistant to Chief (Administration)

Assistant to Chief (Publications)

Sections of

Wood Structure
Wood Chemistry
Timber Physics
Timber Mechanics
Seasoning
Preservation
Veneer and Gluing
Utilization
Mathematical Statistics (CSIR Liaison)

Each section is under the control of a section head or officer-in-charge, who has a number of research officers, technical officers, and laboratory assistants under him. The officer-in-charge is responsible for planning the investigations within the field in which he is particularly interested, and he directs the work of his section and organizes investigations, arranging any necessary co-operation with other sections. He is himself directly responsible to the chief of the Division.

The research sections are backed by an extensive library, staffed by two trained librarians and an assistant; by a typing and records staff; by a publications branch that edits and distributes reports and other publications; and by well-equipped engineering, instrument-making, and woodworking shops that are devoted to the maintenance of equipment and the manufacture of new equipment designed within the division. The total staff numbers approximately 225.

The Section of Mathematical Statistics is a CSIR liaison. This section is located at the headquarters of the Division and assists all research staff in arriving at proper planning of investigations in order that statistical analysis might be possible.

Australian forests contain many large eucalyptus trees.

State Forestry Departments

Each state has its own forestry department, responsible under the government of the state for the administration of the forests within its own boundaries.

As a result of the growing demand for investigation and research into many problems of forestry and forest products, the state governments through their forestry services have in recent years considerably expanded their research activities on problems associated with the growth and protection of their own forests; the establishment of plantations of exotic trees, particularly conifers; and the utilization of forest products.

Other State Governmental and Semigovernmental Bodies

In several states research work in the field under review is also carried out by other state governmental or semigovernmental bodies and officers, such as universities, government botanists and entomologists, and departments of agriculture, in co-operation with the State Forestry Departments.

Private Companies and Organizations

In connection with their industrial requirements, various private organizations, principally pulp and paper companies, have conducted considerable research into the utilization of the native timber species and to some extent of plantation-grown exotics.

Financial Resources of Research Institutions

The research activities of both the Forestry and Timber Bureau and the Division of Forest Products are financed annually on a Commonwealth Government vote of funds, budgeted for each year according to the demands that have arisen and the problems requiring attention.

In the case of the Division of Forest Products, the vote of funds provided by the government is supplemented by regular fixed grants from the three Australian paper companies, and more recently from a New Zealand company that has joined in the program of research into problems associated with pulp and paper manufacture being carried out in conjunction with the division.

Research work by the various state forestry departments is mainly financed by a yearly vote of funds by the state governments. In some cases finance is provided from reforestation funds under the administration of the forestry departments and also from loan funds made available by the state governments.

Private companies and organizations provide their own funds for research.

Research Work and Results

The major types of research work undertaken by the various organizations in the respective fields of forestry and forest products are summarized below.

FORESTRY RESEARCH

Forestry and Timber Bureau
Headquarters Research Station, Canberra, A.C.T.

The Bureau is equipped with a complete meteorological station, and observations are carried out on forest conditions. A plant-house and nursery attached to the Bureau are employed to raise strains of the commercial timbers of Australia.

In the plantations of the Federal Capital Territory, the Bureau conducts sample plot work necessary for the management of the forests and also extensive experiments on various methods of treatment such as thinning and pruning.

In the eucalypt forests of the Territory and other parts of Australia, numerous sample plots are maintained, and tests are being carried out on tree form and the dependence of quality and defects of timber upon growing conditions.

1. *Silviculture*

   Investigations have been carried out on the treatment of cut-over native forests, and studies have been made on the treatment of forest plantations. A definite relationship has been found to exist between the crown spread of a eucalypt and the diameter at breast height. The resistance of coastal eucalypts to frost has been tested. Work has been undertaken to determine the incidence, cause, and possible remedy of spiral grain in timber. Selective thinning tests have shown that it is possible to reduce the mean diameter of the twisted core in the pine. Internal stresses in timber have been investigated. They show that the sheaths of wood laid round the bole of a tree every season are in a state of longitudinal tension; this tension of the fibers exerts a cumulative longitudinal compression on the inner core of the tree, and in large trees the heart may be compressed beyond is elastic limit. Stages of the formation of gum veins and the rates at which they are formed have been studied. It has been shown that, under abnormally dry conditions, fire can become a serious direct cause of veins, owing to the crackling of the bark. Fire may also indirectly cause an increase in vein numbers as it results in a thinning of the live bark and any subsequent injury is brought nearer the wood cambium.

2. *Plant Physiology*

   Experiments have been carried out to gain a measure of the comparative transpiring surfaces of different species of eucalypts. Tests have been made to correlate tree growth with the water content of the soil and meteorological factors.

3. *Dendrology*

   Investigations have been made in regard to the relation between solar radiation and the growth of trees in girth. Seasonal growth of shoots and roots is being studied.

4. *Nutrition*

   Tests have been made on the effect of the applition of various chemicals, particularly the minor elements, to pine plantations.

5. *Genetics*

   Experiments aiming at the vegetative reproduction of the strains best fitted to meet economic and silvicultural requirements have been carried out. It has been found possible to reproduce Monterey pine from cuttings. Studies of the races of Monterey pine have been made and cuttings from defined types have been set out in a cutting nursery. Experiments are being carried out in the grafting, budding, and pollination of conifers, eucalypts, and other hardwoods.

6. *Factors Influencing the Form of the Tree Trunk*

   The effects of various stimuli upon the growth of trees have been investigated. One of these, wind sway, was of particular interest, and the investigation has been carried out in both eucalypts and pines. Results of experiments show that in both Monterey pine and Alpine ash the prevention of sway by the use of wire stays reduced the increment in the lower part of the stem.

7. *Nursery Technique*

   Experiments are being made on improvements in nursery technique, particularly in the use of weedicides.

8. *Pruning*
   Experiments have been carried out to determine the effects of various pruning tools and the rates of occlusion, and also to determine the pruning schedules necessary to reduce loss of increment to a minimum consistent with the production of the minimum knotty cores.

9. *Arboreta*
   Arboreta, which number eight, are situated from the foothills up to 5,000 feet elevation above sea level, and afford comparisons of growth of the various exotics at different altitudes.

10. *Seeds*
    The storage and viability of seeds have been studied.

11. *Forest Management*
    Growth plots have been established and maintained to ascertain the growth rates in both native hardwoods and softwood plantations under different treatments.

12. *Forest Protection*
    The Bureau issues daily fire-weather forecasts in the summer season and is constantly investigating means of improving their reliability. In the case of a disorder known as die-back, signal success has attended the application of dilute solutions of zinc sulphate sprayed on the foliage of Monterey pine. As a result, large areas that were previously regarded as useless have been made available for pine planting. Experiments are being carried out to find the most effective way of destroying mistletoe.

Mount Burr Research Station, South Australia.—Work undertaken by the Station in co-operation with the Woods and Forests Department of South Australia covers the field of fundamental silvicultural research on Monterey pine and may be classified under the following subjects: (1) silvicultural treatment, regeneration, pruning and thinning, seed collection, nursery technique, plantation establishment; (2) nutrition; (3) tree breeding; (4) timber qualities, causes of defects; (5) disorders and diseases; (6) meteorology, including the correlation of growth to meteorological factors.

Hobart Research Station, Tasmania.—A working plan for co-operation in silvicultural research work with the Tasmanian Forestry Commission has been laid down. The plan puts special emphasis on investigations into the silviculture of the eucalypts for a commencement.

The results of the work of the Bureau are published for general information in a series of pamphlets and bulletins.

State Forestry Departments

All states of the Commonwealth carry out research in connection with their normal work of silviculture, management, protection, and utilization. This includes: (1) studies in the phenology and natural regeneration of the native species; (2) studies in nursery technique and the establishment of both native and exotic species; (3) pruning and thinning practices; (4) collection of information regarding growth and yield and the determination of site qualities; (5) investigations in connection with fire control, forest pathology, and forest entomology; (6) logging studies.

In Queensland, South Australia, and Western Australia, particular attention has also been given to research on soils and nutrition. In carrying out the above work the state forestry services obtain the assistance of other organizations such as the Forestry and Timber Bureau, with which a very close co-operation is maintained, and of universities in connection with specialized subjects.

FOREST PRODUCTS RESEARCH

Division of Forest Products, CSIR

The following summary indicates the main types of work carried out by the various sections of the Division.

Wood Structure Section.—This Section has made a comprehensive study of the macroscopic and microscopic characteristics of Australian timbers and has applied the results of its work to identification keys on the one hand and to certain features of investigation of other sections on the other. During World War II, card-sorting keys developed for the timbers of the Pacific Islands were of considerable aid to the Allied forces fighting in that zone. At present fundamental work in the structure of the wood fiber is being carried out.

Wood Chemistry Section.—While interested in various aspects of its particular field of work, this Section has for the most part followed up the pulp and paper investigations initiated by the old Forest Products Laboratory. The Australian pulp and paper industry is now well established, but many problems remain to be investigated, and work on these is carried out under a co-operative scheme with the several paper-manufacturing companies.

Timber Physics Section.—In addition to purely fundamental research into the physical properties of timber, this Section has carried out valuable work in connection with the selection of suitable timbers for such specialty uses as battery separators.

Timber Mechanics Section.—Its earlier work on the mechanical properties of various Australian timbers made it possible, when World War II began, for this Section to suggest species worthy of further test for such critical uses as aircraft construction, and during the war the whole of its effort was devoted to mechanical tests of timber and plywood for such uses. Other major projects include a study of the bending properties of Australian timbers and, more recently, projects designed to meet the need of materials for housing.

Testing the strength and deflection of an experimental floor section. Division of Forest Products, CSIR, Melbourne.

Seasoning Section.—Perhaps the most spectacular achievement of this Section is the part it has played in developing a high standard of kiln drying in Australia. In 1929, timber-drying kilns in this country were relatively few in number and, for the most part, inefficient. Mainly as a result of the activities of the Timber Seasoning Section, kiln drying is established practice throughout the Commonwealth and the majority of kilns have been built to designs provided by the section. Further, many kiln operators have either been trained in the Section or have taken its correspondence course in kiln operation.

Apart from the closely related work of developing suitable kiln-drying schedules and other seasoning investigations, the section has in recent years undertaken several major projects related to utilization problems, the most important of these being sawmill studies and investigation of sawdust-cement and wood-wool-cement mixtures.

Preservation Section.—Some of the earliest projects of the Division were concerned with field tests of poles, sleepers, and fence posts treated with various preservatives. These are still in progress but some valuable information has been obtained already. The Section was responsible for the boric acid treatment of lyctus-susceptible timbers, a process which has now been adopted in both Queensland and New South Wales and is made compulsory for certain timbers in the latter state. Original work towards a systematic study of wood-destroying fungi was interrupted by the war but is now being resumed.

Veneer and Gluing Section.—This, the newest section in the Division, has already done much to assist in the peeling, drying, and gluing of Australian timbers. Work on adhesives is taking an increasingly important place in its program.

Utilization Section.—Dealing with production problems in general, this section applies information obtained by the other sections and gives advice to the industry in accordance with the data so gathered. It also carries out certain laboratory investigations itself and has just completed a survey of sawdust supplies throughout Australia with a view to studying the economic utilization of what has been, for the most part, a waste product. Officers of the Section have been called on repeatedly for advice in the establishment of major wood-utilization industries in Australia.

The results of the work done in the Division of Forest Products are published first in the form of mimeographed progress reports bound in semi-stiff covers, which are given fairly wide distribution. Some reports of a technical nature and of wide interest are published either in the CSIR Bulletin Series or as articles in the CSIR *Journal* or other suitable technical publications. Many results are published in a less technical form in the CSIR Trade Circular series, in the *Forest Products Monthly News Letter,* and in trade journals.

State Forestry Departments

All the state forestry services carry out investigations with a view to improving utilization and extending the field of uses for the different species. They are also actively engaged in investigations covering mill studies, timber grading, seasoning, preservation, and other treatment as well as general utilization economics.

In New South Wales and Queensland the forestry departments maintain sections carrying out detailed research work in connection with the characteristics, properties, and uses of timbers growing in their own states.

In general this work is carried out in co-operation with the Division of Forest Products of the Council for Scientific and Industrial Research. In some particular cases, however, such work is also carried out in conjunction with other state government departments (botany and chemistry), and with local organizations such as universities, technical colleges, and private companies and bodies.

Private Companies and Organizations

Considerable research in the utilization of forest products for commercial purposes has been carried out by various private companies and organizations. The chemical investigations in Western Australia which, as mentioned earlier in this article, resulted in the establishment of the tannin-extract industry in that state, were carried out in co-operation with a private firm. The research work on distillation of sandalwood oil and perfume from flowers of *Boronia megastigma* was also carried out by private companies in association with other organizations.

However, the bulk of the research work by private organizations in this field has been carried out by the pulp and paper companies, of which there are five operating at the present time. These are: Australian Paper Manufacturers, Ltd., operating in Victoria, producing kraft paper from eucalypt timbers; Associated Pulp and Paper Mills, Ltd., operating in Tasmania, producing fine writing and typing papers from eucalypt timbers; Australian Newsprint Mills Pty., Ltd., operating in Tasmania, producing newsprint; Cellulose Australia, Ltd., operating in South Australia, producing paperboard from planted forests of *radiata* pine; Masonite Corporation (Australia), Ltd., operating in New South Wales, producing hardboard manufactured from eucalypt timbers.

Of the companies mentioned, those using eucalypt timbers in the manufacture of their products are actively concerned with the numerous problems associated with the pulping of these short-fibered timbers.

In the chemical pulp plants, established practices had to be modified, particularly in the beating processes; while shortage of long-fibered pulps, which used to be imported from overseas, has necessitated investigations into the possibility of increasing the strength of short-fibered pulps and of producing suitable pulps from other raw materials available in Australia.

During the war, success was attained in producing nitrocellulose from locally grown pine by the kraft process. Much work has been carried out in connection with the bleaching of kraft pulp.

Investigations relating to the utilization of lignin and other organic by-products of soda pulping have been made, and the semichemical pulping of Australian hardwoods has been tested. The manufacture of newsprint has also involved research into new manufacturing methods, particularly in the matter of improved color and quality.

The company pulping *radiata* pine has experienced less difficulty in utilizing well-established methods of pulping, but is carrying out research into the possibilities of extending the range of pulp products from the raw material available to them. Tests show that *Pinus radiata* is little inferior to spruce for the production of sulphite pulp and better than other pines for either sulphite or sulphate pulp. This timber

promises to be capable of providing Australia's future requirements in long-fibered pulp.

In the production of hardboard from eucalypts, the main problems encountered are those dealing with the utilization of a variety of species and the effects of moisture content, the presence of kino, et cetera.

Future Work of the Various Organizations

Forestry and Timber Bureau

As opportunity offers and suitable staff is available, the work of the Research Division of the Forestry and Timber Bureau is to be considerably expanded to cover a wide field of research including:

Silviculture.—Studies of the silviculture of Australian and introduced forest-tree species.

Physiology.—Fundamental research into the physiology of Australia's forest trees.

Tree Breeding. — With a view to improving the form and selecting the most suitable races of the various forest species.

Arboreta.—The establishment of arboreta for the purpose of testing the suitability of forest species for the various climatic and other regions to be found in this country.

Growth and yield studies.—Including the preparation of yield tables and the determination of site quality indices.

Other studies. — Studies in soils, nutrition, forest pathology, and forest entomology.

Forest Products Division, CSIR

The Forest Products Division has reached a sound stage of development in its research activities, and proposals for future work necessarily consist largely of the extension of the existing program and consideration of such new research problems as may arise from time to time. For the next 12 months a program of work has been laid down for each section of the Division. Space does not permit the detailed listing of this work, but some comment should be made on several projects that cover a wide field of research and consequently come within the general scope of the activities of the whole Division. These may be summarized as follows:

Silvicultural Project.—The major purpose of the investigation proposed under this project will be to study the properties of the wood laid down by the tree before and after silvicultural treatment. Work previously begun along these lines was seriously interfered with by the war. It is now proposed to recommence investigations in co-operation with the state forestry services and the Forestry and Timber Bureau.

Investigation of Building Boards. — This project covers extension of investigations into the greater utilization of wood waste and secondary timber species by conversion into some form of building board.

New Guinea Timbers.—Acting in close co-operation with the New Guinea Forests Department, the Division proposes to continue and extend the work on the examination of physical and mechanical properties of New Guinea timbers.

State Forestry Departments

Future research work of the forest services will cover investigations into natural regeneration methods, thinning practices, growth and yield problems, soil and climatic requirements of exotic species, and protection against fire, insects, and disease.

Private Companies and Organizations

While many companies and organizations throughout the Commonwealth will be continuing and extending their research activities on the utilization of timber and forest products in the manufacture of their products, the main research work will be carried out by the pulp and paper companies. This work will be largely associated with improving the quality and extending the range of their present production from the raw materials available to them and with utilizing the by-products of the industry. One company proposes to develop systematic research into problems of regeneration, tending, and protection of the forest crop.

Long-time loading tests on wooden beams are part of a study to investigate "creep" in timber. Division of Forest Products, CSIR, Melbourne.

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Forestry in the Northwestern United States of America

As Seen by a European Forester
on the Staff of the Division of Forestry and Forest Products

ONE of the European members of the staff of the Division of Forestry and Forest Products of FAO has recently visited the forest regions of the northwestern part of the United States.[1]

As has been pointed out by the Chief of the United States Forest Service in the first issue of this magazine, these regions support the last virgin timber reserves of this country—reserves on which the United States may have to depend for the continuance of its lumber supply.

The problems which American foresters face are serious and numerous. Viewing these problems through the eyes of a European forester — in the light, of course, of his own experience as a European forester— may help in the evaluation of the situation and may provoke silviculturists to consider their problems from new angles. On the other hand, it should not be forgotten that the present article represents merely the impressions of one month's travel and consequently cannot be expected to exhaust the question or even to present all its aspects.

The following pages will endeavor to set forth the present situation in the forests and timber industries of these regions as well as to review the chief questions posed by these forests and the methods used by American foresters to find solutions.

Stand of Douglas fir, Pseudotsuga taxifolia, *abundantly mixed with hemlocks,* Tsuga heterophylla, *and noble fir,* Abies nobilis, *in foreground. Oregon, U.S.A.*

The first thing about American forests that impresses the European forester is their size. Since the very complete statistics of the United States Forest Service provide a wealth of data on this subject, it is unnecessary to give details here. But it should be borne in mind that until about a century ago all these forests were virgin forests. As can be seen from the extensive virgin forest areas owned and managed by the Federal Government, however, this kind of forest was not necessarily of climax type.

Fire has indeed been the determining influence on the formation of many stands. It is not correct to assume that man is entirely responsible for introducing this scourge. There was, it is true, deliberate burning down of forest to clear land for agriculture. But as soon as regions were settled, the fires caused by men could also be fought by men. Fires from natural causes have been of greater importance. During the two to four very dry months characteristic of summer in the whole northwestern region, fires begun by lightning could spread unchecked over wide areas because of the large amount of debris covering the ground in these unexploited stands. According to many American foresters, such fires determined, with very few exceptions, the character of virgin stands now surviving and of those which were still existing about a hundred years ago.

Fire has in fact produced its normal effect. The new growth is pure and even-aged over large areas, at least in the upper canopy, although in many places the climax forest gradually asserts itself under this canopy as long as fresh fires do not interfere with the process. Intolerant species, experiencing especially fa-

[1]The Forestry and Forest Products Division wishes to express its thanks, first to the Chief of the U. S. Forest Service, Mr. L. F. Watts, and to the Assistant Chief, Branch of Research, Mr. E. I. Kotok, whose courtesy made possible this trip under the most favorable circumstances; and further to the Chiefs of the Regional Offices and Experiment Stations who arranged the details of this trip, as well as to the many foresters who so courteously guided FAO's representative on his far-flung tour through the forests of Montana, Idaho, Oregon, Washington, and California.

vorable conditions during their early stages of growth, have become dominant in the forest: white western pine, *Pinus monticola* Dougl., in the forests of western Montana and northern Idaho; Douglas fir, *Pseudotsuga taxifolia* Britt., in Washington and Oregon; ponderosa pine, *Pinus ponderosa* Laws., or Jeffrey pine, *Pinus jeffreyi* Grev. and Balf., in California.

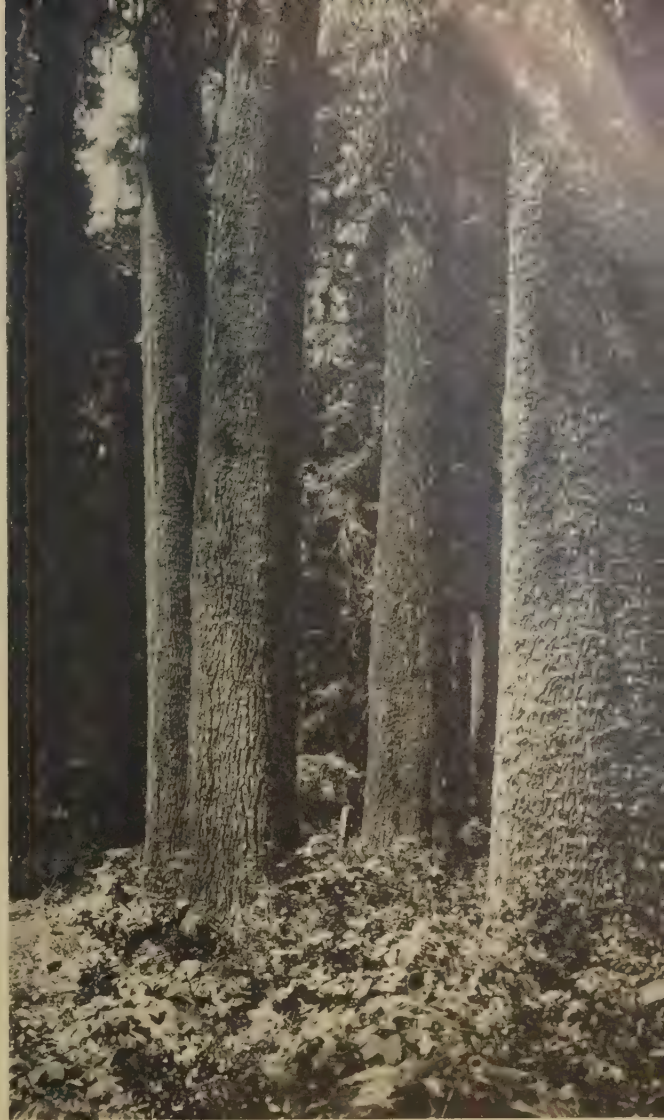
This does not mean that these species, and especially ponderosa and Jeffrey pines, are not a part of the climax forest. On the contrary, these two are obviously the chief elements of the climax association over large areas. It seems certain, however, that fire, obviously in conjunction with climatic influences, has greatly modified the composition of the stands by age and diameter classes rather than by species.

These statements are not meant to imply that the northwestern forests are simple and uniform. On the contrary, they are very complex because the species of the climax forest immediately tend to reestablish themselves under the stands appearing after a fire or, as will be shown later, after an insect attack. The result is a great diversity, first in the species found, and second in their relative proportions. These variations are due not only to the wide range of climate and altitude occurring over such large areas, but also to the fact that in one location the stand may have currently reached a certain stage of its evolution that has not been reached in another, even nearby, location.

Silvicultural Consequences

This situation has had several consequences, some of silvicultural and others of economic significance. Since the stands are pure and even-aged and frequent cuttings are impossible, they have in many cases displayed a high susceptibility to disease and insect attacks. The western white pine, a five-needle pine, suffers from "blister-rust," *Cronartium ribicola*, and, recently, from a canker of unknown origin which spreads rapidly in pole stands. The Douglas fir often shows a troublesome susceptibility to attacks by fungus which cause rotting of the bole. The ponderosa pine and its associates are subject to attack by the western pine beetle, *Dendroctonus brevicomis*, which has become a very important factor in California silviculture, and by another coleopteron which attacks young plants and has in a few years assumed epidemic proportions.

Another feature, very important from the silvicultural point of view, is the lack of middle-aged stands of those species already mentioned, which, up to now, have been considered as the most valuable. In the virgin forests, fires may have occurred at relatively short intervals of time, but their extent and their effects on the different component parts of the stand probably varied greatly. Probably the trees that were mature enough to be protected by a sufficiently thick bark or that had a young stand of climax species less susceptible to fire established under them did not succumb. One cannot explain otherwise the scarcity of the middle-aged classes of these species, and the great size and age of the trees which are now the tourist attraction of the northwestern forests and are responsible for the commercial renown of the northwestern lumber industries. Many of these trees are 200 to 300 years old, and some are over 1,000 years old, as in the redwoods region, *Sequoia sempervirens* (D. Don) Endl.



White pines, Pinus monticola, *in the virgin forest of Clearwater National Forest, Idaho, U.S.A.*

Economic Consequences

The forest conditions found when exploitation began led to the organization, for economic reasons, of the forest industries of each region around one species alone. Up to the last war, the whole forest economy of northern Idaho and western Montana was centered around the western white pine, that of Oregon and Washington around the Douglas fir, that of northeastern California around the ponderosa pine, and that of the coastal region around the redwood. As the stands were composed of very large and relatively inaccessible trees, considerable investment was needed for exploitation so that large firms were in a favored position. Since the stands were also even-aged, clear-cutting methods were almost always used. The remaining trees, very rarely of species considered valuable, were damaged by logging and skidding operations or were unable to survive isolated. The meaning of sustained yield was unknown to the first loggers. Once the land was completely cut over, the sawmills

closed down. Settlements which had grown up around big milling plants have frequently degenerated into ghost towns. The former community of Hobart Mills, California, for instance, stands in ruins today, nothing but a gasoline station at a crossroads.

Obviously these extensive clear-cuttings, begun around 1850, have contributed to the gravity of the silvicultural problem. The stands growing on the cut-over lands are still young and the supply of middle-aged trees is limited or nonexistent.

Forest Ownership and the Lumber Industry

The United States Forest Service groups as "National Forests" large forest areas containing not only government-owned forests but also privately owned forests. Frequently the latter are relatively very large.

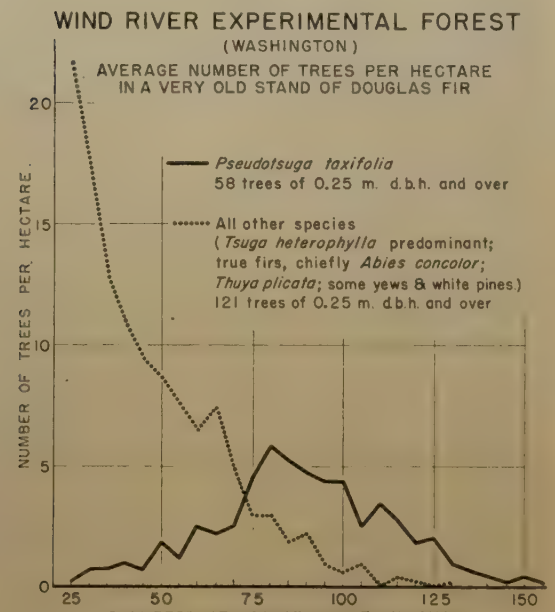
Large Private Forests and Big Business

The privately owned forests are usually the best and most easily accessible. They are generally big estates belonging to one of the big companies, which exploits them directly or sometimes sells the cutting rights to another company. These large areas contain a certain proportion of virgin forests but also a great deal of completely cut-over land, covered only with young trees. Often natural regeneration has had difficulty in establishing itself or has quite given up the struggle.

Although large enterprises are, generally speaking, none too thoughtful about the future of the forests, the picture traced above fortunately applies mainly to the early days of exploitation. At present, many private companies endeavor to manage their forests on a sustained-yield basis, or at least aim to achieve this result after a conversion period, the necessity of which will be shown later. They have a staff of foresters whose training is the same as that of the federal foresters and who are fully conversant with modern silvicultural methods. Their advice is followed and they usually work closely with the regional forest services and experiment stations. This is particularly the case when the forests are close to Government-owned ones and when supply for their mills is dependent not only on their own cuttings, but also on timber to be sold to them from the forests managed by the federal service.

But this is still not the whole picture. It is only too true that some companies are quite unconcerned about ensuring an even and sustained supply for their mills. Examples can be found everywhere. But it is particularly so in the redwood region, where the Forest Service has little or no opportunity for action since the forests are all privately owned except for a relatively small area very recently acquired by the Federal Forest Service. Though a slight improvement is becoming apparent, exploitation methods as a whole are still definitely destructive, and the future of the forests in this region appears very uncertain.

The big companies confine their activities mainly to the exploitation of the virgin stands. Their prime interest is in high-quality lumber from the very big trees of which the forests are chiefly composed, and their equipment is designed for handling such stock. While their methods of exploitation are sometimes very crude in that they leave the forest unproductive for many years and entail an enormous wastage in timber which might well be put to use, the subsequent processing of the material taken out of the forest is highly efficient. Besides sawmills of the most modern design, drying-kilns, and planing equipment, the plants of some of these big companies include also plywood manufacturing equipment to handle the highest quality logs, facilities for the manufacture of crates to use up the smallest sizes of lumber, plants for briquetting sawdust and for utilizing bark, and even, in the state of Washington, an important pulp mill.



THE CLIMAX FOREST TYPE IS BECOMING ESTABLISHED UNDER THE OLD AND DECADENT DOUGLAS FIR

FAO Chart No 172

Small Forest Properties

Besides the large forest holdings, there are also small forest estates which vary in importance in the different states. They comprise chiefly farm wood-lots, the average size of which is about 20 hectares (50 acres). These lands, rich and easily accessible, were among the first to be exploited, and now carry new stands, which American foresters call "second growth," that are generally very dense and of rapid growth. These stands are very far from having reached exploitable size, but they should be able, under wise management methods, to yield a return of some value from thinnings.

Small Enterprises

Alongside the big lumber concerns, there are also smaller sawmills. Their number, in fact, considerably increased during World War II. According to regional foresters, these small-scale industries do not have sufficient equipment and capital to cope with virgin forests; they must concentrate their operations on second growth, inducing smallholders to sell their timber before it has reached maturity and full value. During the war, the Forest Service sold stumpage to these small sawmills in order to step up pro-

Virgin stand of ponderosa pine, Pinus ponderosa, *mixed with sugar pine,* P. lambertiana, *in the Stanislaus* ***National Forest, California, U.S.A.***

Logging and yarding in the redwood, Sequoia sempervirens, *region, California,* U.S.A.

duction. Under these circumstances, logging standards were good but wastage during conversion was high. No use was made of the considerable quantity of waste material. Many of these small sawmills, dependent on the National Forests for their raw material, have been obliged to close because they were unable to meet the expenses involved in competition with the big companies.

The Timber Market

In closing this summary of the lumber industry situation, it should be noted that in many regions the financial incentive is insufficient to warrant the application of sound silvicultural methods. There is a similarity here between the virgin forests of the northwestern United States and those of tropical regions. It is true that some species have always been marketable for definite uses, such as the western red cedar, *Thuya plicata* Donn, for shingles, or the incense cedar, *Libocedrus decurrens* Torr., for pencils. But before World War II most of the secondary species were considered worthless. This is still the case in Idaho and Montana except for small quantities of cedar and western larch lumber. There is no market, either in these two states or in California, for pulpwood. Consequently, in these regions, foresters are unable to dispose of timber considered of low value for sawings, nor is it economically feasible to carry out the thinnings which are now necessary and which will become even more urgent when the present young stands reach 30 to 40 years of age. However, construction of a large pulp-mill in the San Francisco area is contemplated, which may help this situation locally.

The Problems

The Management Unit

European foresters seldom have to solve the problem of the management unit. The forests they administer are relatively small and are often divided up into different ownerships; and there are enough relatively small sawmills (by comparison with the big American plants). Often the management unit is just the extent of one owner's property. If this is too extensive and it is thought necessary to divide up the area to be cut over in order to provide neighboring sawmills with an adequate supply, the tendency is to divide the coupe into series rather than to form large contiguous blocks. During many centuries a balance has been achieved between forest production and the normal capacity of the sawmills.

The situation is quite different in the northwestern United States. It must be pointed out, however, that in the Balkans, as in the United States, exploitation of the virgin forests has necessitated the creation of big companies. In France, too, for the development of the last virgin forests of the Basque country during the first world war, large areas of forest belonging to various communities had to be grouped together so as to provide a sizable volume of timber for the big companies, to justify the large investments needed for organizing logging operations.

The northwestern forests are difficult of access, covering mountainous country and steep slopes, cut by innumerable narrow canyons. Except for the valleys through which roads and railways pass, most of this region is still very sparsely populated. A few years ago many of the valleys were still considered inaccessible for logging. Going up into them, one finds only scattered logging camps, designed in relative comfort to last a few years but obviously temporary in character. Even some of the big sawmills are built on the expectation of a limited lease on life and the communities that have grown up around them are essentially impermanent.

The selection of a management unit—an area of the forest which will continuously supply a definite amount of timber and consequently a definite amount of work for the inhabitants of a community, mill workers, and loggers—is linked up, therefore, with a real problem of settlement and of the opening up of the forest.

In deciding on the management unit, account must usually be taken of privately owned forests, often interspersed with state-owned forests. The timber resources they can potentially supply must be combined with those of the public forests to assure the existence of the community which it is desired to create or to stabilize. In fact, recent legislation has authorized the Forest Service to enter into agreements with owners under certain conditions, so as to incorporate into "co-operative sustained-yield management units" private forests adjoining publicly owned forests. These units will be administered under the same rules of management as the state forests. This law, now in operation, will help solve in some cases the problem of the management unit.

Generally speaking, the Forest Service divides every National Forest into "working circles," which are chiefly administrative units but which may well serve in the future as management units. In most cases, however, and almost inevitably, the establishment of these management units involves the co-operation of the Forest Service with the big lumber companies. This is so true that, where there are no big enterprises working, the Forest Service must wait for the construction of a big plant in a favorable location or even encourage or facilitate such construction before opening a new exploitation unit or organizing a co-operative unit.

In the United States itself, criticism has been voiced against this policy because it involves a risk of giving to big industry a kind of monopoly over large portions of the publicly owned forests. The risk has been foreseen by the Forest Service and steps have been taken to minimize it. However, it must be understood that, for the rational management of these units, the Forest Service *needs* the co-operation of the lumber industry and of powerful companies, and vice versa. The first essential of rational exploitation, for instance, is the construction of a complete road network, in order that every part of the management unit can be easily reached. The Forest Service sometimes has a large enough appropriation to open the main road, or "access road"; however, it is unable by itself to open the secondary roads that are required for the regular management of the unit, and these must be very numerous because of the rough terrain to be traversed.

Large industrial plants are or can be focal points, around which important communities grow up. Thus the stability of existing communities or the creation of new communities, which is the object sought in creating management units, is often closely linked with getting the major timber industries on a permanent basis or establishing big new companies.

Cutting Policy and Methods

For a good understanding of the silvicultural policy generally followed by the Forest Service of the northwestern United States, it must again be remembered that the forests it administers are largely virgin forests.

The losses in a normally composed virgin climax forest are, on a statistical average, approximately equivalent to the gross wood increment. In order to harvest a net increment through regular exploitation, it is first necessary to eliminate as quickly as possible the components which are chiefly responsible for the losses, the mature and over-mature trees which are the prey of fungi, insects, and pests of all kinds.

The virgin forests of the Northwest are not climax types, but their composition produces the same results. Where the forests are left to themselves, losses from natural causes are much greater than the gross wood increment, at least as far as the merchantable timber is concerned, without taking into account young and middle-aged stands. It is necessary, therefore, to rid the crop of trees which would in any case be lost before a new cutting could be made on an area already cut over; this is the policy followed by the Forest Service.

The considerable stumpage put up for disposal enables the big operating companies to invest large sums in road construction. The complete network of roads built up facilitates normal management as soon as the "conversion" operation is over. In fact, this policy gets results, and the development of the road network where cutting is in progress or has just been finished is astonishing.

Various methods of cutting are practiced, according to species, maturity of the stand, and its future prospects. Generally speaking, the main trend is towards selection cutting, which approaches the "jardinage" methods of European foresters. Very fine stands can be seen in which the first cutting has taken only 25 percent of the growing stock above 12 inches in diameter, and this proportion is not very far from that of an average "jardinage" cutting. The two kinds of cutting cannot be precisely compared since "jardinage" cutting involves, in principle, every kind of cultural operation in every kind of stand met with on the area involved, while selection cutting is concentrated in general on the trees most likely to die off. But it seems probable that the two kinds of cuttings will become increasingly similar once the growing stock has been regulated, and this trend is already noticeable in some cases.

In adopting selection felling, American foresters hope to be able to extend the harvesting of the old stands of virgin forest over as long a period as possible, so that the young stands now in existence will be ready for exploitation as soon as the old stands become exhausted. Thus the menace threatening the lumber industry from the lack of middle-aged stands could be averted at least in part, and more so if thinning and improvement fellings could be carried out economically in the young stands so as to hasten the growth of the best trees. In most areas there is no outlet for thinnings, but the Forest Service is authorized to retain part of the stumpage price of all sales.

Thee types of cutting — clear cutting, clear cutting with scattered seed trees, and selective cutting — in the Willamette National Forest, Oregon, U.S.A.

instead of turning it over to the Treasury, on the condition that this money is used in improvement work. It is thus enabled to carry out local thinnings and prunings which seem very worth while.

However, selection cutting, even with heavier fellings than indicated above (the normal rate being about 65 percent), is not always possible. Some stands are, as a whole, so over-mature that all marketable trees must be taken out. In the western white pine region some foresters think, perhaps rightly, that clear-cutting is the only way to ensure predominance of this valuable species in the regenerated stand and that the disadvantages of clear-cutting can be avoided if carried out in narrow strips, leaving belts of standing forest. In the Douglas fir region, clear-cutting over relatively small areas under these conditions gives good results from the point of view of regeneration, though selection cutting, with a sufficient opening-up of the canopy, would give the same satisfactory result.

Finally, it must be kept in mind that selection cutting is possible only when suitable logging equipment is available. Most loggers now operate with powerful and easily handled tractors and very mobile cranes for loading the logs on trucks. However, where the "slack-line" system is still used, as it is generally throughout the redwood region, selection cutting seems almost impracticable.

Even clear-cutting practice has improved considerably in recent years in that quantities of timber previously left at the site are now recovered. One improvement is the practice of "relogging," or going over a previously cut area again to harvest fallen trees or those left standing that are unlikely to survive to be of any use in the forest of the future. Another improvement is the practice of "prelogging," which is the removal, before the main cutting operation starts, of suppressed trees of any value or smaller trees that might otherwise be damaged and probably lost. The logging companies have realized that in many cases these two practices are not only economically feasible, but that they yield a considerable amount of timber, often increasing the volume of the main cut by a quarter or a third.

Following selection cutting, the many access roads opened up make it economically possible to carry out so-called "salvage" cuttings, which roughly correspond to the annual harvesting of windfalls practiced by European foresters. It is to be hoped that this practice will be followed more and more so that the removal of trees that have died after the main crop has been felled may add to the net yield a volume which previously could only be considered as a dead loss of forest capital.

Other Major Problems

The very numerous problems facing American foresters in the Northwest cannot all be discussed within the limited scope of an article such as this. In general, they concern chiefly regeneration, protection, and the silvicultural methods best suited to each type of forest. Three outstanding problems, however, deserve special mention:

Fire.—The first of these problems is fire. American foresters have fought against fire with every means that modern technicians could put at their disposal: a network of trails and roads permitting ready access for fire-fighting crews; numerous "look-out" towers, manned day and night during the danger season and linked by very complete telephone and radio systems; specially trained mobile teams, with equipment carefully planned down to the last detail; a watch system reinforced by air patrols, generally in co-operation with the Air Force; even the use of parachutists for swift attacks on fires in places otherwise inaccessible; intensive propaganda throughout the country, making the public aware of the danger of forest fires; control of tourist traffic and camping.

These efforts have borne fruit. Obviously, it is too much to say that forest fires in the Northwest will now never get out of hand or spread over large areas. In recent years, however, the number of fires and especially the average area burnt over have been decreasing to such an extent that fires can now be considered as a normal forest hazard just as the risk of windfalls is in European forests. They have ceased to be a constant threat against carefully thought-out management plans.

However, forest administrators must be constantly prepared to meet critical fire situations, for the threat of fire will always remain a characteristic feature of the northwestern forests. It is, indeed, a direct consequence of the climate—of the summer drought, with sometimes a complete lack of rain for weeks, together with violent winds and a very low degree of relative humidity. Perhaps the establishment of a climax forest type would result in stands less sensitive to fire. These are questions that should be carefully studied by experiment stations. Except in the most favorable circumstances the fire threat cannot be entirely eliminated.

Closely tied to the fire problem is the question of slash disposal. It comes as a surprise to a European forester to see the quantities of debris lying around after a felling, but this can be explained by the high proportion of dead or dying timber occurring in virgin forest. If just abandoned, this slash would constitute a grave fire hazard for many years. Even in selection cutting, it must sometimes be burned; but generally, with this method of felling, the slash does not amount to much and is thinly spread over a large area. After tops and branches have been broken down so that everything lies uniformly on the ground, the debris can be left to be covered by the first snowfall, which will hasten decay. Sometimes, however, the slash for some distance on either side of roads, where the risk of a fire starting is greatest, is piled and burned. When more intensive cutting methods have been practiced, the slash must be burned. In some cases, it is done by broadcast-burning, but where advance regeneration or trees left standing need to be protected, the slash may first have to be piled.

Bound up also with fire is the maintenance of plantations, which forms one of the most important activities of the Forest Service. The nurseries are indeed outstanding; it should, however, be noted that while European foresters prefer relatively small nurseries, well distributed in order to avoid too much adjustment for the young seedlings when transplanted, American foresters prefer to concentrate nursery work on large, well-chosen sites. Apparently mortality is no higher than in European nurseries, and this system makes it possible to provide each nursery with excellent equipment—not only for collecting and drying cones and preserving seed, but also for the cultivation of the nursery itself—and to use mechanical

methods as far as possible for packing and for storing the seedlings in refrigerator chambers after they are dug up.

Most of the plantations are raised on burnt-over areas. Cost and chances of survival vary greatly with the condition of the soil. Very often burnt-over ground, especially after several fires, is invaded by an abundance of small deciduous trees in the north and, in the south, by thick scrub of various species of Manzanita, *Arctostaphyllos spp.*, chinkapine, *Castanea spp.*, and numerous varieties of *Ceanothus*. Large areas covered by this type of vegetation were planted up during the depression, but the cost was prohibitive, particularly where the scrub had to be eradicated strip by strip. The Forest Service therefore prefers to concentrate its efforts on the best soils and on areas recently burnt over, where there is no competition from brush. The results are generally excellent.

Blister Rust.—The second problem is "blister rust," *Cronartium ribicola*. This is particularly serious in Montana and Idaho, because of the importance of the western white pine, but no less so in southern Oregon and in California, where it threatens the sugar pine, *Pinus lambertiana*, Dougl., a magnificent tree that is locally abundant.

There are not many ways of combatting this disease and all of them rest on the elimination of the various species of *Ribes* to be found in the understory. It is possible to obtain natural regeneration of white pine by maintaining the canopy so dense, even after the seeding felling, that the *Ribes* cannot establish itself. It is then usually necessary to protect the pine against the competition of other shade-tolerant species such as hemlock, *Tsuga heterophylla* (Raf.) Sarg. But it is rarely possible to retain a canopy of sufficient density in stands containing a high percentage of mature trees which have to be felled. Broadcast burning of slash, if carried out two or three years after a clear cutting, when the *Ribes* has had time enough to germinate, destroys the pest. The *Ribes* seeds can remain indefinitely in the soil without losing their germinative powers. But it can be eliminated only over clear-cut areas, and clear-cutting too often has other drawbacks.

The only remaining solution, therefore, is to ensure complete eradication of the *Ribes* by hand. This is what foresters there have been doing by organizing crews specialized in this kind of work. Some experiments in trying to eliminate *Ribes* by spraying 2,4 D have been carried out, but the effectiveness of this method is as yet unknown and it is doubtful whether it would be less expensive than extirpation by hand.

Small Forest Holdings.—The third problem is eco-

Forest fire in Willamette National Forest, Oregon, U.S.A.

nomical and social in character rather than silvicultural: it is the problem of the small private forest holdings.

The position of such forest owners and the danger which threatens them have been pointed out. The foresters' action on this question can take the form only of advice, given through the medium of state organizations. The number of agents assigned to this task, now only two or three in each state, could be increased with great advantage. Wherever these specialists have been able to exert their influence, it is interesting to note that they have been very successful and that many farmers seem very receptive to progressive ideas concerning silvicultural practices.

Forest Research

The attitude of northwestern foresters toward the problems just enumerated and means of solving them is not just a blind groping for practical solutions. On the contrary, it involves the application of scientific methods, carefully tested by experiment stations working closely with the regional forest services in every forest region of the United States. Compared with the organization of European experiment stations, generally concentrated in a limited number of places and having only occasional contacts with the executive services, this type of organization is both original and interesting. Such an organization was a necessity for American silviculture, especially in the Northwest.

The whole ecological evolution of European forests is well known. Their history, against this scale of evolution, is relatively easy to determine because the essential factor has been repeated cutting. The small number of forest species and the similarity of their development over relatively large areas also simplify the picture.

The U. S. Forest Service, on the contrary, has had to deal in the Northwest with forests where only natural factors have influenced the evolution of the stands, and often with a violence unknown in Europe. The diversity of climate, soil, and altitude and the large number of forest species prevented a clear reading of the history of the stands or the determining of the reaction of a given species to a given treatment. The whole ecological history of these forests had to be reconstructed, and this task, which is still on the whole the main task, clearly indicated the necessity for numerous experiment stations spread all over the country.

On the other hand, in Europe, or at least in those European countries which practice the most advanced silvicultural methods, every forest, every exploitation unit, is in itself an experiment which the forester in charge is able to follow very carefully. The most striking example can be found in the forests managed by the "control method," a form of management which enables the forester to know at practically any moment the exact stage in its evolution that the growing stock has reached and permits him to influence the stands at the very place and time that such action will be most useful.

These methods cannot be applied to western forests in the United States for the following reasons. The present composition of the forests, because of their origin, does not lend itself to a slow evolution but necessitates a short conversion period during which European management methods would be meaningless in practice. The forests as a whole still have too few access roads, a situation that could be remedied perhaps by a considerable increase in appropriations for the Forest Service. Their products do not as yet have the outlets which would be needed to make the necessary silvicultural operations profitable. Lastly, these forests are spread over vast areas, and the only remedy for this difficulty would be a great increase in the number of foresters.

Consequently, the best policy was to establish research stations in as many types of forests as possible and to study there the problems presented by each of these types from an economic as well as a silvicultural point of view. As soon as solutions were found and duly tested by scientific methods, they could be applied to scale to all the forests of the particular type.

In other words, one can say that, whereas the method of working European forests is individual in character, since it divides the growing stock into small units with individual characteristics, the treatment of the forests of the northwestern United States is statistical in character. Undoubtedly this is due to the conditions facing the Forest Service of the United States and to the problems which it has had to solve from the beginning. But it is highly probable that the statistical method of working will remain indefinitely a characteristic feature of silviculture in the northwestern United States, first because all the conditions given above, and chiefly the last one, will never be fulfilled, and second because the statistical method is perfectly justifiable when it is applied to large forest areas. It has already shown astonishing results and its efficiency in these forests is comparable to that of any other method used elsewhere.

It must be further pointed out that these methods

The Institute of Forest Genetics, Placerville, California.

Cutting in a private forest, Washington, U.S.A. Dark-colored slash has been burned over.

have been an important factor in the progress of scientific forestry in its many aspects in the United States and particularly in the northwestern regions.

It would be easy to show many examples of the statistical character of the methods used by American foresters based on the research work of the experiment stations. Two may be quoted as particularly striking.

1. The Black Mountain Experimental Forest

The European forester who visits the Black Mountain experimental forest in northeastern California is surprised to find all the elements of the "control method" very strictly applied here. This forest, about 4,000 hectares (10,000 acres) in extent, is managed so as to obtain the highest possible sustained yield. The method of working is very similar to "jardinage," taking into account that it is applied here to an intolerant species, the ponderosa pine, and to virgin stands the composition of which is very far from normal. The management system which determines cutting is as flexible as the "control method," and even more so, since in order to be able to carry out any cultural operation at the appropriate time wherever it may be necessary, the experiment station has its own logging crews and its own logging equipment. Also a complete forestry inventory has been made.

This forest, however, is an *experimental forest*. The general aim is to determine what silvicultural methods to apply so as to ensure sustained yield, to determine whether such methods are economically feasible, and eventually to evolve silvicultural methods that would be actually applicable from the economic point of view. These rules could then be applied to all forests of this type, which cover nearly 1.5 million hectares (3.7 million acres).

This over-all experiment includes also many other experiments. The complete inventory has been made only to verify the accuracy of the sampling methods currently used in forests of this type. In the management plan, some compartments are ear-marked for cutting according to certain methods in order to determine not only the silvicultural results obtained with every one of them, but also their effect on the cost of harvesting. Elsewhere experiments deal with methods of thinning and pruning.

2. Survey Methods

The second example will be taken from the survey methods used by American foresters, the statistical

character of which is particularly apparent. A complete inventory of the large northwestern forests is obviously impossible. However, the sampling methods evolved by the experiment stations, which have been greatly improved by the use of aerial photography and which are used now over the whole forest regions, give the Forestry Service the chance of acquiring as accurate a knowledge of their forests as they wish. And this knowledge can cover all factors: composition by species, by volume, by diameter categories or by tree-class; rate of growth; amount and kind of regeneration; and mortality.

The use of these methods has had a two-fold advantage for American foresters. First it has given them probably a much more accurate knowledge of the whole of their forests than many European countries can boast. If European foresters can say that they know with a high degree of certainty the composition of the forests under their administration—an advantage which they will probably not have very much longer because of the rising cost of complete inventories—they are in almost total ignorance of everything concerning the privately owned forests, over which they have no control. Even in the forests which they administer, they have often only a vague and merely approximate idea of some factors, such as the number and kind of seedlings and young trees not included in the inventories.

Secondly, the use of the sampling method in all public and private forests has familiarized every American forester with statistical methods. These methods again are applicable to all research activities and it is certain that the knowledge thus acquired plays an important part in the achievements in all fields of experimental research, such as the calculation of fire hazard, the planning of the fight against insects and diseases, methods of planting, the study of conditions of natural regeneration for every species, and finally and above all, the study of genetics, to which the Placerville Institute has given such a promising and powerful impulse.

Because many problems of the northwestern forests are similar to those which arise in tropical forests—a similarity which has already been pointed out—a study of the problems of the former ought to be helpful in planning the development of the latter. American foresters, indeed, have perfected methods of forest survey, research, exploitation, and protection which must hold the attention of tropical forest technicians. Also the types of logging, hauling, and sawing implements used in the northwestern lumber industry should be of interest to technicians in charge of the utilization of virgin tropical forests.

At present the essential feature of northwestern forestry is the conversion of virgin forests into stands which are managed to make them yield determined amounts of wood every year, supplying industry with the most valuable timbers. This is also the essential problem which foresters in charge of the development of tropical forests face. It can be said that the experiment of northwestern forestry is of fundamental interest to these foresters because it will have been completed relatively quickly. In a few decades the population of that part of the United States has increased enormously and this development is continuing, making not only possible but necessary the transition from an extensive to an intensive silviculture, similar in aims if not in methods to European silviculture.

It is obviously impossible, after only a brief visit, to express any valid opinion about the future of the forests of the northwestern United States. Only foresters with intimate local knowledge can make an adequate forecast, though a great many factors, chiefly economic, which may exert a profound influence are beyond even their control. It seems unlikely that timber of such exceptional quality as that now being exploited will be obtained again from the crops which foresters are aiming to grow on a rotation of only 120 to 175 years. This excellent quality is probably due to the great age (200 to 300 years and over) and the slow growth of the timber. On the other hand, increment will probably be much greater and net yield will not be constantly lowered by high mortality. The loss in quality, perhaps exaggerated, may again not be as important as at first appears, in view of probable trends in the lumber industry. However, a period of crisis is to be anticipated, owing to the lack of middle-aged stands. This crisis could be largely averted if the cutting of the old virgin stands could be extended over a sufficiently long period, and especially if in the meantime markets could be created in each region for the species now considered of minor value.

Whatever the future of these forests may be, America's foresters will have accomplished a gigantic task in these regions. Not only will they have opened up the forests, but they will have transformed these timber lands from a prey to disease, decay, and pests into valuable stands which can be managed along rational silvicultural lines. They have developed and are still improving their methods of silviculture, and they have at the same time developed original research methods from which all countries may benefit and have obtained general results which will be of major importance for the future of scientific forestry.

They have a right to be proud of their work and of their national forests.

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The Work of FAO

The Third Session of the FAO Conference

September 1, 1947 was forestry day at the annual session of the FAO Conference at Geneva. In two plenary meetings, Commission II of the Conference examined world policy on forestry and forest products. The decisions taken at these meetings constitute an important step, not only in the development of international co-operation between foresters, growers, producers, and consumers of timber but also in the trend toward a new common world policy for all the products of the land and of the sea.

In contrast with decisions taken at preceding sessions of the Conference, these relate to a limited number of major projects that can be got under way at once. They are thus a sign that FAO has progressed from the stage of making programs to that of putting them into practice.

It was this change that led the Geneva Conference to set up a new procedure for the discussions. Like its predecessors, the third session of the FAO Conference devoted only a few days to plenary meetings, the main tasks being performed by several large commissions sitting simultaneously. This time there were three commissions, which dealt respectively with (1) the world situation in food and agriculture; (2) technical activities of FAO, and (3) administrative, constitutional, and financial problems. But while at Quebec and Copenhagen each commission was subdivided into committees to carry out the bulk of the work, the commissions at the Geneva Conference dealt with the items on their agendas in plenary sessions.

This new procedure was adopted chiefly because of the experience gained at Quebec and Copenhagen. In point of fact, the referring of different questions on the agenda to committees of experts has serious disadvantages, shown in a striking way by the experience of the forestry and forest products committees at the Quebec and Copenhagen Conferences. These committees had always succeeded in formulating their recommendations and conclusions with an astonishing unanimity; nevertheless, their recommendations gained hardly any attention from the principal delegates to the Conference and still less from their governments. Approved by the Conference, they remained for the most part a dead letter; and the principal aim of the Conference—to draw up programs and recommendations which governments by their votes pledge themselves to carry out—was not fulfilled. Other technical committees had a similar experience, but the case of forestry is particularly striking since the heads of governments and even the ministers responsible for agricultural and industrial production are in all countries inclined to consider forestry problems as a specialty that must be left to experts.

The discussion of technical problems in plenary sessions avoids the disadvantages of the committees of experts. It is true that within the framework of such discussions the time available for the Forestry and Forest Products Division is very limited, but this applies also to the other divisions. And to compensate for it, the discussion now takes place in the presence of the principal delegates (who are not specialists) and of the public and

Palace of Nations, Geneva, where the Third Session of the FAO Conference was held.

the press who are thus obliged to give all their attention during six hours to problems which they are not used to considering and to appreciate their importance for the world economy and the well-being of the peoples.

Obviously many forestry experts wondered whether a single day devoted to discussions justified the long and costly journey which many of them had had to take to be present at the annual session of the FAO Conference. The answer is that the principal object of their journey was to participate in a great common work of which forestry constitutes an important part. The task of each delegate was to put before his colleagues from other countries and other sections of the agricultural and forestry economy his special problems, but at the same time to listen to their points of view and to give them the same attention as he expected to receive.

It is necessary to take account also of the fact that the forestry and forest products committees of the 1945 and 1946 Conferences were not a world parliament. On the one hand, time was much too limited to allow detailed discussions. On the other hand, participation in those committees was neither uniform nor complete; certain countries were represented by practical foresters, others by growers or by technological or international timber-trade experts, while some countries were not represented at all for the simple reason that their delegations were not large enough or did not include forestry experts.

During the course of the past year certain questions had already been studied by conferences of experts, such as the statistical conferences held in Washington and Rome, and by the technical committees. This practice will be extended and will enable the annual session of the Conference to examine at a higher level a great variety of well studied subjects. The plenary sessions of Commission II were the ideal place for such a survey.

The discussions in the commission did not, however, constitute the only form of contact between foresters and timber experts. At the first meeting of the commission, its outstanding chairman, P. J. du Toit, the delegate of South Africa, suggested that the experts take advantage of the Conference to hold meetings among themselves. This suggestion was followed, and in the days preceding 1 September, the Director of the Division of Forestry and Forest Products was able to arrange for several meetings devoted to the more detailed study of the progress report and of the program of work for 1948 which he had prepared. During these meetings, held under the chairmanship of Professor E. Saari of Finland, the finishing touches were put to the list of questions to be discussed by the commission, and Bernard Dufay, Director-General of the Water and Forests of France, was nominated as rapporteur for forestry questions. This choice was unanimously confirmed by the commission on the opening of the discussions.

As a result of this preparation the two meetings of 1 September were able to cover a wide field. In fact, after the work and program of the Division had been presented by its director, the commission adopted no less than twelve recommendations, which will govern the activities of FAO in the matter of forestry and forest products for 1948 and even later. These recommendations are as follows:

(1) Approval of the recommendations of the International Timber Conference at Marianske Lazne.

(2) Approval of the closest co-operation between FAO and the Economic Commission for Europe.

This will imply the organization of a Timber Subcommittee for Europe as a permanent organization.

(3) Recommendation that the European countries concerned should meet together from time to time within the framework of FAO to exchange information and views about their problems in the field of medium- and long-term forestry.

This will mean periodical consultation between experts, leading to the creation of a European Commission

for Forestry and Forest Products, in which all interested governments will participate.

(4) Convocation in 1948 of a conference devoted to the study of forestry and forest-products problems in Latin America.

(5) Preparation for a forestry conference of the countries of southern and eastern Asia, if possible before the end of 1948.

(6) The organization in 1949 of a third World Forestry Congress, and the provisional designation of Finland as the country where the congress will be held.

(7) The sending of experts to study forestry problems in the Mediterranean area and the Near East.

(8) Development of the review, UNASYLVA.

(9) Approval of the statistical program of FAO, both for the preparation of an inventory of forest resources and for the publication of annual and quarterly statistics on forest products, thereby permitting implementation of the conclusions of the statistical conferences held at Washington and Rome.

(10) Recommendation to member countries to establish forestry and forest-products subcommittees as part of their FAO national committees.

(11) Approval of the work of the Advisory Committee on Forestry and Forest Products and notably of its method of work, which consists in delegating to subcommittees each of the specialized problems forming part of the work of FAO.

(12) Necessity of including a forestry expert among the members of all FAO general agricultural missions.

Attendance at the meetings of 1 September was commensurate with the importance of the questions dealt with, and showed the increasing importance attached to the part played by forests in the world economy. Professor Myrdal, Executive Secretary of the Economic Commission for Europe, was present at the discussions concerning European forest policy, and F. L. McDougall, Counselor of FAO, followed the discussions very closely throughout the day. Practically all the seats around the table, where a place had been reserved for each member and observer country, were occupied, and the length of the speeches was limited only by the time available, a matter that had to be strictly watched by the chairman. A. Fjelstad, delegate of Norway, who, since the Hot Springs Conference has never ceased to work for the cause of forestry within FAO, drew the attention of delegates to the discrepancy between the Division's program and its budget. He was followed in the discussion by E. I. Kotok, Assistant Chief of the U. S. Forestry Service, who has always played his part in FAO's work and discussions on forestry questions. Bernard Dufay gave fresh proof of the clearness and courage which characterize all his speeches. H. G. Winkelmann, delegate of Switzerland, and G. Zvérina, who had represented Czechoslovakia at Copenhagen, Paris, and Marianske Lazne, were also present.

To these old friends were added newcomers, notably Professor E. Saari, the well-known Finnish forestry expert, who, as chairman of the Finnish delegation, brought his country officially into FAO. Count A. Ceschi was there, the Austrian well known for his international activities before the war, and also Inspector-General Colleaux of Belgium and D. Caplan of the United Kingdom, who had both participated actively in the work and success of the Marianske Lazne conference. Finally the growing interest of the Latin American countries was shown by the participation of forestry experts from Chile, Colombia, and Brazil. Mr. Ducci, the young organizer of the modern forest industry in Chile, was frequently their spokesman.

Forestry questions were discussed not only in Commission II of the Conference. Forest products, and particularly building timber, were also on the agenda of Commission I, and a fairly complete report on the world situation as regards building timber, wood pulp, pit props, and other forest products was prepared for the delegates. Nevertheless, the discussion of these problems in Commission I took only a fairly short time as the subject had been studied in such detail at the Marianske Lazne Conference that the annual session of the FAO Conference had merely to confirm the conclusions reached at the former gathering.

The situation will doubtless be different at the next annual Conference, when Commission I reviews the activities of the FAO Council, the new body whose establishment was the principal work of the Geneva Conference. Timber has already been entered among the products that will be given immediate attention by the Council. During the coming months the Council will follow up, on the one hand, the evolution of world needs and availability of timber and, on the other, more particularly the work of the Timber Subcommittee of the ECE and its efforts to bring about a definite understanding between governments on the subject of timber production and distribution in Europe.

The annual session of the Conference in 1948 will be even better prepared to discuss the question of forestry products since the statistics to be gathered by the Forestry and Forest Products Division from now until the date of the Conference will enable the relation between present and future world needs for forest products and the productive capacity of the world's forests to be expressed for the first time in terms of figures.

The next annual session of the FAO Conference will be marked by another innovation as a result of decisions taken at Geneva: in future the chairmen of the Standing Advisory Committees to the five technical divisions of FAO will form a Co-ordinating Committee that will perform the technical and administrative functions of the former Executive Committee of FAO, which was discontinued as a result of the constitutional changes voted at Geneva. For his part, the chairman of the Standing Advisory Committee of the Forestry and Forest Products Division will consult his colleagues before the annual session of the Conference and will be able to present their conclusions to Commission II of the Conference.

A similar procedure had in fact already been adopted this year: the report on activities and the program of work presented by Marcel Leloup to Commission II had previously been examined and revised by the Standing Advisory Committee on Forestry and Forest Products in the course of a meeting held in June 1947 at Washington. However, this procedure—to be followed next year in a more official form—will have increased importance.

At the next annual session of the Conference, also, a more formal role will be given to the consultations between foresters and timber experts in order that the problems which interest them may be discussed in detail before they are examined by Commission II. In this way the advantages of the new procedure, which has proved efficacious at Geneva, will be retained, while experts from all parts of the world will be given new possibilities of coming into contact with each other and taking a truly active part in the elaboration of FAO's world policy.

Pending the next annual Conference, the Director of the Forestry and Forest Products Division has already begun to carry out the decisions of the Geneva Conference: the first Year Book of Forestry and Timber Statistics will be published shortly; the Timber Subcommittee of ECE has already held its first meeting and is ready to meet a second time. Its secretariat, installed at Geneva, is made up of technical staff from FAO. Preparations are in progress for a forestry conference in Latin America.

The Second Session of the FAO Standing Advisory Committee for Forestry and Forest Products

The Standing Advisory Committee for Forestry and Forest Products held its second session in Washington, D. C. 26-28 June 1947. This committee, made up of specialists in various fields of forestry and forest products techniques, serves as a consulting body to advise the Division on means for implementing policies adopted by the FAO Conference. Its members act as chairmen of technical subcommittees.

Seven members of the committee, the Director of the Division of Forestry and Forest Products, and the heads of the Division's branches were in regular attendance, while various staff members of the Division were present at appropriate times. Lyle F. Watts, Chief of the Forest Service, U. S. Department of Agriculture, was elected chairman and H. G. Winkelmann was appointed rapporteur.

A report on the Division's work during 1946/47 was presented by the Director and reviewed, attention being focused especially on the forestry and forest products statistics conferences that had been held in Washington and Rome to determine the lines along which statistical investigations should be pursued, the international timber conference at Marianske Lazne (reported in the previous issue), the work of the technical subcommittees, and new appointments to the staff.

All the projects scheduled in the Director's proposed program for 1947/48 were approved as of considerable importance. The following items were discussed in detail.

The proofs of the first number of *Unasylva* were examined and approved. It was proposed to investigate the possibility of including a bibliographical section which would cover a wider field, both geographically and by language, than is now covered by any existing agency abstracting information on forestry and forest products. The importance of organizing the translation of technical works was also stressed.

The committee was agreed on the value of technical subcommittees, and adopted as the framework for their organization a general classification into five categories, in each of which one or more subcommittees would be formed as found desirable. The formation of the following subcommittees within the framework of these five categories was approved:

Category (1) Silviculture and Forest Management (a) Research (b) Management;

Category (2) Technology of Forest Products (a) Mechanical (b) Chemical;

Category (3) Economics and Statistics (a) Lumber (b) Pulp and Paper;

Category (4) Education (a) Education;

Category (5) Special committees (a) Unexploited Forests.

Missions of two kinds were noted according to the method of their initiation: namely, those proposed and paid for by a member country and those proposed and paid for by FAO by reason of the urgent need to examine certain problems on the spot. The committee considered that missions in the second category should be organized during the coming year to investigate specific problems of the Mediterranean area and the virgin forests of Latin America. Regretting the omission of a forestry expert from the mission to Greece in 1946, it stressed the importance, in recognition of the close relations between agriculture and forestry, of including forestry experts on all general or agricultural missions.

In discussing regional problems, the committee endorsed the Director's proposals for the Division's activities in Europe, which consisted primarily of a continuation of the work initiated at Marianske Lazne. B. Dufay, Director-General of Waters and Forests, Ministry of Agriculture, France, was elected chairman of the proposed European Forestry and Forest Products Commission, which will work with the Division in fields outside that covered by the ECE Timber Subcommittee. The committee expressed doubts that the budget allocation would permit full implementation of the proposals relating to the establishment of a strong forestry and forest products service to work in Europe as part of the Division, and it pointed out that failure in this regard might prejudice the future work of the Division and the prestige of FAO in Europe.

The program proposed for Latin America was noted with satisfaction, previous recommendations concerning the desirability of detailed investigation into the Parana pine situation being reaffirmed. For the Far East, especially China, the urgency of replanting large areas and the necessity for well-concerted measures in that region were stressed. The view was expressed that a forestry conference for the Far East should be held, if possible, before the end of 1948.

The fact that only a few member countries have established forestry subcommittees within the national FAO committees was noted with regret; the Committee believes that such subcommittees are essential to the Division's work as the best means for developing regular contacts and securing proper co-operation.

The committee proposed calling a world forestry congress for 1949 to survey new methods that recent advances in science are placing at the disposal of foresters. This congress would especially examine urgent silvicultural problems connected with the development of virgin forests, the question of minimum standards of forest management capable of assuring sustained yields, and reforestation problems with special regard to the most recent advances in phytogeography, phytosociology, and soil study.

The committee also considered a report, "World Situation and Outlook for Forestry and Forest Products," presented by the Director, and declared itself in general agreement with its structure and conclusions.

Finally, the committee recommended that the documents presented by the Director, amended in accordance with its suggestions, and its own report on the items mentioned above be made available to member governments of FAO prior to the Conference at Geneva in August, to give them a general picture of the world situation in respect of forestry and forest products and to apprise them of the past and projected work of the Division.

The Activities of the Subcommittee on Mechanical Wood Technology

The Subcommittee on Mechanical Wood Technology was set up in accordance with a recommendation made by the Standing Advisory Committee for Forestry and Forest Products at Oslo in August 1946. In September of the same year the FAO Conference at Copenhagen ratified this recommendation, and drew up the working program of the subcommittee, requesting that the following points be taken into consideration:

(1) Standardization of grading rules for lumber and a technological classification of woods in relation to their uses.

(2) Elaboration of standards for mechanical testing of wood.

(3) Elaboration of building codes for the use of architects and contractors; improvement of building codes and use of modern equipment and methods of assembly.

(4) Methods of improving properties of wood by chemicals.

These general recommendations have been quickly carried out. The subcommittee, formed at the end of 1946, is composed of fifteen qualified experts in the field of physical and mechanical wood technology, chosen either for their position or their previous work in the various countries. As suggested by the Standing Advisory Committee, they were chosen not as representatives of their countries, but as experts capable of considering different technical problems from an international viewpoint.

In order to reduce traveling costs, it was agreed to divide the subcommittee into a European and an American group, which would discuss the problems separately and exchange information. In accordance with this arrangement the European group held its meeting at Zurich (Switzerland) 11-16 January 1947. The American group met several months later, 7-10 July, at Washington, D. C. Less than a year after the Copenhagen Conference, therefore, the Subcommittee on Mechanical Wood Technology had been formed, had begun to work, and had even reached important conclusions on certain points.

A summary of the main points that have been discussed by the subcommittee and of the conclusions reached is given below.

First the question of standardization was considered. Both on national and on international levels it is becoming increasingly necessary to use the same technical terms and definitions and the same methods for measuring, testing, and establishing specifications of wood products. During the past few years a great effort has been made in this direction, and the subcommittee was of the opinion that it should do its best to advance this work.

From the first discussions it was apparent that two main points of international standardization are possible: (1) technological classification of lumber and standardization of lumber sizes; (2) standardization of specification tests, both physical and mechanical, of wood and of wood products.

The most important discussion on standardization of testing methods was held at Zurich. It was decided to ask the different laboratories specializing in timber research to collaborate in the work of the subcommittee. For instance,

the Forest Products Laboratories (U. S. A.), and Princes Risborough (Great Britain), the Institut National du Bois (France), and the EMPA Laboratory (Switzerland) have promised their wholehearted co-operation with regard to the unification of testing methods. A rapporteur was appointed, whose work will soon be submitted to the experts of the subcommittee. It is not too much to hope that important results will be achieved in this field in 1947.

At Washington the standardization of lumber dimensions came under review. Although testing methods are applied by only a small number of specialists, the questions of lumber technology and classification directly concern the greater proportion of timber users and merchants. Trade and technical practices and economics vary greatly from region to region and may vary even within one country; this makes the problem very difficult. It is, of course, not technically possible to adopt a universal scale for determining the dimensions of all sawn timber, but it is doubtless possible to create some order out of the present chaos. For example, it should be feasible to prepare a model list, giving as simply as possible the different dimensions standardized for softwoods in various countries. The subcommittee could not settle it in a few days however. It has requested the Division of Forestry and Forest Products of FAO to facilitate exchange of information on practices existing in different countries with a view to examining to what extent international standardization of dimensions is possible. The problem is still being studied and in the next few months further steps may be made towards the solution.

Besides the general question of standardization, a second important item in the program of the subcommittee is the best method of utilizing wood in construction. The rational utilization of wood must, indeed, be considered as of primary importance. On the one hand, in a period of scarcity, it reduces consumption through economy in the use of material, while in normal times it enables timber construction to sustain comparison both technically and economically with other types of construction and so helps to strengthen the competitive position of wood as against substitute materials. All these points have been discussed and have received the attention of the subcommittee. It has also been decided to study construction methods and building codes. Very substantial progress in construction has been achieved in various countries during the past few years. It is time now to apply this knowledge and, if possible, to improve upon it. The subcommittee believed that a complete study of new construction methods should be made both in Europe and in America. An inquiry regarding building codes for timber construction has been sent out to various countries with a view to comparing the rules in force and attempting to draw up a world technical code based on acquired experience. At the same time it has been decided to assign to qualified experts the study of the use of wood in dwelling construction and prefabrication. In this way, complete documentation will be collected. The results of this study should then be published as completely as possible, to provide the member nations with information on the most modern and rational principles of building construction.

The study of construction is not complete without a consideration of timber preservation. During the meeting at Washington, the attention of the subcommittee was drawn to modern methods of preservation and new preservative products. The preservation of wood in certain tropical countries was also studied. The use of rational construction methods that allow for all the characteristics of wood largely prevents attacks by insects and decay. However, there are certain cases where wood is particularly exposed and where preservative treatment is indicated. The Division of Forestry and Forest Products of FAO was asked to act as a center of information on this project. It will collect information concerning preservatives and methods and will disseminate it among member nations. Laboratories which have especially studied this question—in particular, the Forest Products Laboratory at Madison, Wisconsin, U.S.A.—will give their full co-operation in this matter.

These are the most important questions that have been discussed. But other problems that are important in the rational utilization of wood have also been considered by the subcommittee. The utilization of waste, the transformation of sawdust and shavings into fiberboard capable of replacing boards, and the substitution of sheathing in construction have been subjects of deliberation by the American group, which considered it advisable to follow up development of this work both on the technical and on the economic level.

In the opinion of the subcommittee the elaboration of an international terminology for wood technology would promote exchange of research and documentation among technicians of various countries. A resolution was taken that this work should be begun as soon as possible by the Division of Forestry and Forest Products of FAO in co-operation with members of the subcommittee and the laboratories and other organizations they represent.

It is hoped that the coming year will bring the first fruits of the collaboration of timber technicians, both from the Old and New Worlds, which has emerged these last few months from the Division of Forestry and Forest Products of FAO.

ECE and FAO Co-operate to Solve Europe's Timber Crisis

The new Timber Subcommittee of the Economic Commission for Europe met for the first time in Geneva, 15 to 19 October. The session marks the opening of a new and promising chapter in the history of international co-operation with regard to European timber production and trade.

The beginnings go back to the end of World War I but it took the depression of 1932 to bring about the first concerted effort. Attempts to regulate and stabilize European timber trade, initiated by the Economic Committee of the League of Nations in 1932, were subsequently undertaken by the Comité International du Bois (CIB), and culminated in the European Timber Exporters Convention (ETEC) concluded in 1935 at Copenhagen among the nine leading timber-producing countries of northern, eastern, and central Europe. Interrupted through the outbreak of World War II—except for Germany's attempts to adjust timber trade to the needs of its war economy—this cooperation was resumed in 1945 by the Timber Subcommittee of the Emergency Economic Commission for Europe (EECE) and a year later by FAO's Division of Forestry and Forest Products. In May 1947 the International Timber Conference at Marianske Lazne was able to agree on a broad international program, with regard to both short-term and long-term developments. And almost the same day that the report on timber, prepared in Paris by the 16 nations participating in the Committee of European Economic Co-operation, was presented in Washington, the ECE's Timber Subcommittee started its activities in Geneva.

Despite numerous changes in the sponsoring institutions, the delegates meeting at international timber and forestry conferences have frequently remained the same, thus assuring a far greater degree of continuity than might be assumed at first sight. The Chairman of the Geneva meeting was Gunnar Lange, Swedish Under Secretary of Agriculture, who had presided over the third committee of the Marianske Lazne conference. Mr. Dufay (France), Mr. Cerf (Belgium), Count Ceschi (Austria), Mr. Bretherton (United Kingdom), and many other delegates knew each other from Marianske Lazne, Paris, London, and Copenhagen, and in some cases even from timber conferences before the war. There is a French saying that "men change, institutions remain." In European timber relations, the opposite has happened.

Even before leaving for Geneva, most delegates were aware that this first session was not likely to reach binding agreements with regard to 1948. In seven meetings the committee was able to review the situation and to agree on production and requirement estimates that reduce the prospective European softwood deficit substantially below previously discussed figures for 1948 and beyond. The conference at Marianske Lazne had assumed a European deficit of 2.5 to 3 million standards. Six months later the Paris report concluded with a softwood deficit of 1.15 million standards for the participating coun-

tries; adding the requirements of the rest of the European area and the Mediterranean, and European export obligations to other continents, roughly 2.1 million standards was arrived at. The Geneva meeting was able to reduce this figure by another 25 percent.

This still leaves a deficit of 1.6 million standards, representing roughly 30 percent of the essential softwood importing requirements of western and southern Europe. But even more alarming than the size of the deficit is the question whether the estimate is realistic. Already in 1947 some exporting countries have not sold all the wood available for export despite an acute timber shortage. As late as May 1947, importing countries were satisfied that the essential import requirements as announced at Marianske Lazne constituted the minima they were anxious to import and prepared to pay for; since then, however, European currency difficulties have become so serious that several importing countries have had to cancel contracts and interrupt negotiations for further timber purchases as they were unable to provide the dollars or hard currencies that the producers were asking for. At the same time, some exporting countries decided to pile up timber stocks rather than sell against soft currencies that could not buy the goods they needed to import.

This situation threatens to become even more serious in 1948. Before entering into a discussion of measures designed to eliminate the remaining gap between prospective supplies and requirements or of schemes for the satisfactory distribution of supplies, the Timber Subcommittee asked the Executive Secretary to explore the nature and size of currency difficulties as they affect timber trade and to discuss with governments and competent international organizations possible remedies and solutions.

The Executive Secretary was also entrusted with two further mandates. The Soviet Union was not represented at the meeting. Yugoslavia was, but was unable to take an active part in the discussions. Romania, though not a member of ECE, was invited, but no delegates arrived. It is believed that these three exporting countries might be able to contribute substantially to increased European timber supplies. The Soviet Union and Yugoslavia are members of the Economic Commission for Europe, have taken a regular part in the work of the main commission, and can therefore be expected to participate also in the work of the technical subcommittees. For that reason the Executive Secretary was requested to make contacts with the exporting countries not represented this time, with a view to their participation at the next meeting.

A further point calling for clarification refers to supplies of steel, equipment, food, and coal necessary for maintaining and increasing timber output and exports. Producing countries submitted lists of requirements that must be met if they are to achieve their timber production goals. These requests for special allocations are being reviewed by ECE's Industries and Materials Committee, which met in Geneva 22 November. Once again the Executive Secretary was requested to act as spokesman for the Timber Subcommittee, and to use his influence to secure the special allocations that constitute a prerequisite for timber production.

In addition to these mandates on policy issues, the subcommittee agreed on certain principles of international cooperation. Its main purpose is to prevent serious maladjustments, to the detriment of the weaker importing countries, as a result of sales and purchases made before the conclusion of a more formal European timber agreement.

The report adopted at the end of the subcommittee's meeting contains also a fairly specific outline of work to be undertaken by the secretariat. It includes the collection and dissemination of periodic statistics on timber production, consumption, and trade. It requests the secretariat not only to follow the softwood position, which was the main topic of this first session, but also to collect information on pitprops, hardwoods, plywood, fiber building boards, and railway sleepers, all of which the subcommittee intends to deal with. And finally the subcommittee suggested investigations with regard to timber consumption and possible economies in use, and also the preparation of plans for the industrial development of new forest resources.

To readers who have studied the Marianske Lazne report and the programs adopted for the Division of Forestry and Forest Products by FAO's annual Conference, many of these assignments will sound quite familiar. This is inevitable, even though the interest of ECE's Timber Subcommittee is confined to regional aspects, because it would be difficult to draw a line where FAO's interest ends and ECE's jurisdiction begins. For that reason discussions initiated even before the conference at Marianske Lazne have led to a working arrangement between FAO and ECE that provides for the continuous co-operation of these two bodies on timber matters. This arrangement had received the blessing of FAO's annual Conference, and was now formally approved by the Timber Subcommittee. In accordance with its terms a Forestry and Timber Office of FAO has been installed at Geneva in the Palais des Nations, and an FAO staff assists ECE in running the Timber Subcommittee's secretariat and in carrying out its new technical assignments.

The Geneva outpost of FAO's Division of Forestry and Forest Products will also be able to follow developments not connected with ECE's Timber Subcommittee. It will act in regular contact with FAO's temporary European Office in Rome. It will also be able to take part in the work of various European committees and research groups, both in the field of forestry and in the field of forest products.

When FAO was established with headquarters in Washington, many European foresters and timber experts, who had participated in earlier international efforts, expressed some concern that their particular problems might not receive due attention. They were told that these apprehensions were unfounded and that one of FAO's early developments would be to establish special facilities in Europe.

This promise has now been fulfilled. Europe's forestry and timber problems will be followed from a European center. They will be linked up here with an organization capable of co-ordinating timber and forestry problems with all other sections of Europe's economy. But they will also be closely integrated with FAO's world forest policy, which becomes increasingly necessary as Europe's forests are seen as no longer capable of supplying the needs of Europe's people.

First Meeting of FAO's Subcommittee on Wood Chemistry

THE FAO Technical Subcommittee on Wood Chemistry was convened for the first time on 3 September, 1947, at Appleton, Wisconsin, U.S.A., under the Chairmanship of Dr. Herman Mark of the Polytechnic Institute at Brooklyn.

The following papers were presented for discussion:—

1. The Chemical Utilization of Wood in Japan (H. R. Murdock)
2. Nomenclature, Testing, and Specifications (R. G. Macdonald)
3. Wood Sugar and Sulfite Spirit (J. A. Hall)
4. Lignin (H. F. Lewis)
5. Wood Resin (E. Ott)
6. Improved Cooking Methods (E. C. Jahn)
7. Chemical Wood Utilization in South America (H. Mark)

The reports on conditions in the Far East and Latin America stressed the need in those regions for technical assistance and trained chemists and engineers to stimulate better utilization of forest products. Appropriate measures to provide such help are now under consideration by the Subcommittee.

On the basis of the report on "Nomenclature, Testing, and Specifications" the Committee members agreed on the possibility of arriving at an international standardization, and recommended the drawing up of a preliminary report on this subject.

Many interesting technical details were given regarding operation of the wood sugar plant sponsored by the U. S. Department of Agriculture and completed in January 1947. Although this plant is not actually operating, it can, in the opinion of engineers responsible for its construction, operate efficiently and produce alcohol beyond its estimated capacity.

In the report on "Lignin" the lack of interest in the fundamental study of that material was pointed out. A real research program would be a matter of current importance to the pulp and pa

The Institute of Paper Chemistry, Appleton, Wisconsin, U.S.A.

per, the lumber, and the organic chemical industries, while its future utilization might touch the economic well-being of the whole world. The Subcommittee favored the creation of an annual prize intended to promote research in the field of lignin.

The importance of wood resin is considerably greater than indicated by the facts. The unit value and the aggregate money value of these resins are high because of the unique combination of chemical and physical properties obtainable from them by purification and chemical modification. It is not likely that such versatile raw materials will ever be obtained synthetically at such a low cost.

The report on "Improved Cooking Methods" described the many improvements that have come into use during recent years and pointed out the definite trends in industrial practice toward improved pulping techniques. There is great activity in regard to the use of new species, particularly hardwoods. Particular attention was given by the Committee to the semi-chemical pulping process in view of its fundamental importance to undeveloped countries and to the possible establishment of small units with comparatively little capital investment.

Subcommittee meeting on wood chemistry at Appleton, Wisconsin. Left to right: H. R. Murdock, J. A. Hall, A. J. Stamm, C. B. Purvis, J. Cornell, G. Greaves, E. Ott, N. de Felsövanyi, S. C. Semmens, W. F. Gillespie, E. C. Jahn, R. G. Macdonald, J. R. Succar, H. F. Lewis, H. Mark.

Since the beginning of the century the wood chemical industry has made tremendous strides; world output of pulp is now some 25 million tons, a figure which lies, in over-all magnitude, in the same category as the leading metals and oils and several basic foodstuffs. However, compared to the annual cut of the world's forests, this figure is comparatively small and tremendous possibilities still lie ahead.

FAO's Participation at the Fifth British Empire Forestry Conference

THE Fifth Conference of the forest authorities of the British Empire met in London on 16 June 1947, and continued its sessions until 19 July 1947. Sir Roy Robinson (now Lord Robinson), Chairman of the Forestry Commission of Great Britain, acted as Chairman of the meetings and D. Roy Cameron, Dominion Forester for Canada, was elected Vice Chairman. The conference was attended by more than 30 delegates from Great Britain, 71 from the overseas Dominions and Colonies, and representatives of special forestry organizations having their headquarters in England. A representative of the United States Forest Service and two members of the Forestry and Forest Products Division of FAO attended by invitation.

The first Empire Forestry Conference was held in England in 1920 and succeeding conferences took place in Canada (1923), Australia and New Zealand (1928), and South Africa (1935). Plans for a conference to be held in India in 1940 were disrupted by the war. This unique series of gatherings, which periodically bring together senior forest officers from the widely differing parts of the British Commonwealth, has been most successful in promoting the development of good forest management. Opportunity has been pro-

vided for the personal exchange of views as well as for more formal consideration of reports and programs covering the widest variety of conditions and problems. Through the conferences a spirit of co-operation and mutual helpfulness has been developed. In addition, it has been found that individual conferences have performed a most valuable function in stimulating public interest in forestry questions in the countries in which they were held.

Meetings of the Fifth Conference were held in London, Cambridge, and Oxford, and various forests and industrial installations in England and Scotland were visited. Arrangements were made to enable delegates who were especially interested in forest products to see as many manufacturing plants as possible.

An important feature of the Conference was the presentation of a series of reports prepared by the forest authorities of the United Kingdom, the self-governing Dominions, and the Colonies, which describe the part played in the recent war by the forests of the Commonwealth. These reports were prepared in accordance with a commonly accepted outline and reviewed all aspects of the forestry and forest products situation throughout the war years, including the establishment and operation of the various systems of control introduced by the different governments. Special efforts were made to draw attention to the lessons learned during the war and to preserve those lessons for future reference. The reports were supported by comprehensive statistics covering the forest resources and production, consumption, and trade in forest products. In these statistics the annual averages for the five-year period, 1934-1938, were stated as a basis for comparison and detailed figures were given for each year from 1939 to 1945, inclusive. While the Conference was in session the statistics were assembled and summarized by the Central Statistical Office of the United Kingdom, and these summaries were incorporated in a special report.

Committees of the Conference were established to consider special problems relating to land use, the survey of forest resources, forest management, silviculture and protection, forest products research, timber supplies and marketing, and forestry education. In connection with the last-mentioned subject, special opportunities were provided for delegates to examine the work being done by the School of Forestry and the Imperial Forestry Institute at Oxford. In addition to the work of committees, the full Conference heard and discussed a large number of technical papers prepared by experts from various parts of the Commonwealth.

The Conference considered at some length the question of co-operation with the Forestry and Forest Products Division of FAO. S. B. Show, chief of the Forestry Branch of the Division, and J. D. B. Harrison, chief of the Forest Economics Section, were invited by the Chairman to explain in detail the programs of the Organization relating to forestry and forest products and the methods through which it was hoped to make those programs effective. The proposed international statistical program was examined with particular attention. Representatives of the Organization were assured that it can expect the fullest co-operation from the Government authorities represented at the Conference, within the limits of the means at their disposal.

Among the resolutions finally adopted, particular interest attaches to the proposal that a preliminary survey of the forest resources of all members of the Commonwealth should be completed by December 1957, this survey to take full advantage of recent developments in aerial survey technique. It was recommended that the Government of the United Kingdom should set up a technical committee on the aerial survey of forests to provide guidance and advice on technique and to disseminate information on improved methods. Another resolution stressed the need for clear-cut planning based on the allocation of each type of land to the purpose for which it is best suited in the long-term interest of the national economy. With regard to timber supplies, the Conference felt that regulated overcutting during the emergency period following the war is necessary and justified, but demanded that governments should pay adequate attention to forest protection and later correction of the overcut by working-plan revisions.

In the course of the proceedings the Chairman paid special tribute to the Indian Forest Service which, after 90 years of service to Indian and Empire forestry, was about to be disbanded because of the establishment of the new Dominions of India and Pakistan. A special resolution was adopted in which the Conference expressed to the present and past members of the India and Burma Forest Services its appreciation of the great services rendered by them to forestry in the territories under their charge and in the British Empire at large.

Opening of the Empire Forestry Conference, London, 16 June 1947.
(Photo by courtesy of Sport & General Press Agency, Ltd., London

News of the World

The news items appearing here are condensed selections of what was thought to be of interest to the readers of UNASYLVA. Should readers desire particulars on any given item, the Division of Forestry and Forest Products will welcome correspondence and will endeavor to furnish further details.

BELGIUM.—The variety of Douglas fir known as *Pseudotsuga taxifolia* var. *viridis* is giving very good results in Belgium. At the arboretum of Gedinne a 40-year old plantation on a pattern of 2 m. x 1.50 m. now has a total volume of 667 m^3 per hectare after having furnished 260 m^3 per hectare of thinnings. This corresponds to an average annual production of 23.2 m^3 per hectare. For the period 1935 to 1943 the annual increment was 5.9 percent. Other exotic species giving good results in this arboretum are *Larix leptolepis, Abies grandis, Picea sitchensis, Picea excelsa,* with yields of 10 to 15 m^3 per hectare.

CANADA.—A large, new industrial timber development is being started in British Columbia by the acquisition of some 4 to 9 million m^3 (1,000 million to 2,000 million board feet) of timber on Vancouver Island by a Danish company with world wide interests comprising teak-milling operations in Siam, rubber plantations and tin mines in Malaya, and other global interests.

Tree seeding by aircraft is being tried out. The seeds of white and red pine and red spruce have been dropped from an airplane on a tract of 240 hectares (600 acres) of burnt timberland. The seed is specially coated to increase chances of survival. Approximately 12,500 seeds are dropped over each hectare (5,000 seeds per acre).

Helicopters have now been introduced in fighting forest fires. Two methods of attack are planned—one, hovering over the start of the fire and dropping fire extinguishing chemicals and nipping the fire in the bud, and the other, of laying down a barrage of chemicals against the wall of fire. Fleets of trucks will carry containers of fire-extinguishing chemicals as close as posible to the fire, the helicopter will load up and fly to the wall of fire and bombard it with the containers which are set with a fuse to explode on contact with the ground.

CHILE.—A recently published report furnishes interesting data on the country's forest resources. The total area covered by forests, plantations, and woodlands is 16 million hectares or 22 percent of the total area, representing a ratio of 3.2 hectares of wooded surface per inhabitant. Commercial forests amount to 1.1 hectares per inhabitant. Brushwood, which can be used only as fuel, covers 55 percent of the wooded surface; natural forests, 44 percent; and plantations, 1 percent (principally of *Pinus insignis* and Eucalyptus. Seventy-six percent of the area of natural forests can supply marketable woods, 80 percent of the commercial forests are still in a primeval state, 9 percent represent secondary growth, and 11 percent have been laid bare by fire or clear-cutting. The total volume of sound wood is estimated at 1,843 million m^3, found mostly in the southern provinces. Of this, 1,090 million m^3 could be utilized as sawn timber. Fifty-four percent of the wooded surface is privately owned, 43 percent publicly owned, and on 3 percent the title is contested. The main commercial woods are *Nothofagus obliqua, Nothofagus procera, Laurelia serrata, Laurelia sempervirens,* and *Persea lingue.* Conifers account for only 7 percent of the wooded surface but comprise beautiful stands of *Araucaria araucana syn. imbricata,* and *Fitzroya cupressoides syn. patagonica.* The annual cut is around 5 to 6 million m^3 of which ¾ are used as firewood. Forest fires, however, have destroyed some 8.7 million m^3 of wood annually during the last few years.

CHINA.—The provincial government of Fukien has drawn up a transitional program of economic recovery in which the production of wood and paper have been allotted a very important place. The first step will be to make an inventory of timber production possibilities in the province and of the amounts the markets of Hong Kong, Shanghai, Hankow, Canton, Tientsin, Tsingtao, Formosa, and Chinkiang can absorb. Four paper mills have been established and research work is being undertaken in order to improve the quality of the paper and to give workers and management of the mills the necessary technical guidance. Eighty-two percent of the total area of the province has an elevation of 200-500 meters above sea level and is therefore unsuitable for rice growing. The provincial research station has shown that in this type of hilly country, soil planted in tea, bamboo, or timber shows a yield 750-5,000 times higher per area than rice growing.

CZECHOSLOVAKIA.—It is intended to reforest an area of 150,000 hectares over a period of 7 years. This area comprises 90,000 hectares of forest clear-cut during the war and 60,000 hectares of waste lands. It is further intended to reduce fellings for 1948 to 12.3 million m^3 as part of a 20-year program of reduced fellings to offset the damage of about 23 million m^3 overcutting during the war.

FINLAND. — An Institute for Forest Tree Breeding has been founded for the purpose of encouraging scientific tree breeding. The work of the Institute will draw on the experience gained in North America, Denmark, and Sweden. An inventory for the purpose of ascertaining the best trees and the best stands for breeding purposes will be undertaken. Adequate personnel, buildings, and nurseries have been made available. The Institute will be supervised by a committee, including, amongst others, the Director of Government Forests and representatives of the farmers and of the sawmill, plywood, and paper mill industries.

FRANCE.—According to official statistics, the toll that fire has taken in the forests of the *Landes* in the departments of Gironde, *Landes,* and the Lot Let-Garonne for the years 1942 to 1946 is as follows:

Year	Fires	Surface (hectares)
1942	263	52,311
1943	544	100,949
1944	596	63,732
1945	385	88,814
1946	244	51,849
Total	2,032	357,665

These figures include, of course, tracts which were burned over before 1942 but on the whole it can be assumed that the statistics remain below the actual damage done. It has been authoritatively stated that the whole wood surface of the *Landes* is now reduced to something like 600,000 hectares as against 950,000 hectares in 1937 when artificial reforestation was interrupted. Of the fires in the 5 years dealt with in the above listed statistics, 51.4 percent were due to carelessness (smoking, camping, burning of waste, tractors, etc.), 16 percent to causes related to the war (the occupation, gunfire, bombardments, etc.), 12 percent to acidental causes (railways, high tension wires), 11 percent to wilful damage, 6.4 percent to lightning and 3.2 percent to poorly organized fire fighting (badly put-out fires).

A study is being made of the possible use of plant hormones in the forests of the *Landes* of Gascony. Three methods appear feasible: 1) By using the properties of some of the hormones to increase the growth of rhizomes to ensure regeneration by cuttings. This would permit vegetative reproduction of selected pine strains with high resin yield. The development of the roots of young plants would be helped by the use of these hormones; 2) By the use of hormones in large doses to cause the death of certain plants. It might be possible to combat in this way an excessive grass cover and the formation of an understory representing the principal fire hazard in forests of maritime pine; 3) By the application of certain hormones on the working face and their injection into the trunk of the maritime pine, a method likely to activate the flow of resin.

A general survey of the forest industry shows a very marked increase in production from 1945 to 1946. Total production of timber in 1946 was 10,169,344 m^3 of roundwood, 66 percent above the 6,066,343 m^3 of 1945. Total output of wood for industrial uses has been

2,515,027 steres for 1946, a figure 9 percent higher than the 20,489,466 steres of 1945. Every item has shown notable progress with the exception of wood and charcoal for charcoal gas, where a decline of consumption is the normal corollary of the return to use of gasoline for motor vehicles.

FRENCH EQUATORIAL AFRICA. — Here also output has increased. It is nearly 100 percent higher in 1946 with 100,000 metric tons of wood, as against 56,000 in 1945. Okoumé logs account for 90 percent of these totals. Further progress, however, will have to surmount serious difficulties.

GREECE.—War damage to the forests has been severe, the timber on 25 percent of the wooded area having been destroyed. Only 3/5 of these damaged forests are capable of natural regeneration. Foresters must, therefore, limit themselves to the artificial reforestation of the remaining 2/5 without being able to continue their ambitious reforestation program started before the war. Of the total area of Greece, 15 percent or 1.918 million hectares is really covered with forests. The main species are *Abies cephalonica* (229,000 hectares), *Pinus halepensis* and *Pinus brutia* (420,000 hectares), various oaks (671,000 hectares), and beech (193,000 hectares). Forty-three percent are coppice, 26.5 percent are coppice with standards, and 30 percent are high forests. Approximately 3 million m^3 of sawn timber would be necessary for reconstruction purposes. Domestic sources, however, can account for only 200,000 m^3 of round timber per annum, a supply which would have been insufficient even before the war.

INDONESIA.—Elaborate plans for sustained timber production are being worked out. Production would center around Palembang (Sumatra), Bandjermasin and Sampit (South Borneo), and Sorong (Dutch New Guinea). Most of the output was consumed locally before the war, but exports to Singapore and the east coast are now contemplated. The big coniferous forests of South Borneo, the potentialities of which were only discovered a few years ago, are expected to supply Europe and Australia, as well as parts of Indonesia. Shipping is the principal difficulty because of poor harbors.

MOROCCO.—The country's reforestation plan covers a period of 25 years and extends to 2 million hectares of arid soil and poor or cut-over forest lands. The 500 km. of forest roads existing in 1925 have now been brought up to 3,000 km. A forestry school at Ifrane will give forest rangers their initial schooling.

POLAND.—Poland is making great efforts to reverse past trends by halting the decrease of the forest area and by means of intensive reforestation. There have been 80,000 hectares earmarked for replanting. Plans call for adding 2 million hectares to the existing forest area in the course of the next 20 years. These plans are to be aided by a campaign for the reconstruction of sawmills destroyed during the war and for the fuelwood allotments and the best possible utilization of waste production.

SWEDEN.—The Swedish forest research institutes are now using some 12,000 trees of selected superior pines and spruces for seed production. Refrigeration is being used for the study of frost resistance of seeds of individual species. One of the species it is hoped to acclimatize in this fashion is the *Pseudotsuga taxifolia*. On the other hand, experiments are being carried out with hybrids to combine the characteristics of certain varieties of Norrland's pines with the more rapid growth of the southern Swedish varieties.

Another field of research is the use of X-rays in order to achieve the polyploid varieties which might produce giant trees of very rapid growth. Until now it has been possible to grow a tetraploidal aspen with 76 chromosomes, while the usual giant aspens only have 57 and the common aspen a mere 38 chromosomes. The tetraploid aspen will reach maturity at the age of 30 years.

UNION OF SOUTH AFRICA. — Jonkershoek Forestry Research Station in the Transvaal since its establishment in 1935 has been studying the effect of afforestation on water supplies and the conservation of water and soil. These experiments will take nearly half a century to complete. Recently, a reconnaissance trip was made to areas reputed to have lost water through afforestation. The forestry department is considering the idea of laying out a special experimental area in the eastern Transvaal mountains to find out whether gum tree plantations dry up the streams that have their sources there.

UNITED STATES OF AMERICA.—A tree planting machine which gives promise of radically modifying reforestation has been developed and is now being demonstrated. The unit is designed for use on open field and cut-over land. It can be pulled by any light farm tractor and requires two men to operate it—one for the tractor and one for the planter. It is capable of planting approximately 10,000 seedlings per eight hour day, whereas two men could plant only 1,000 to 1,500 trees for the same period by hand. The machine opens a 23-cm slit in the ground and the plow lifts the soil on each side of the slit but does not compress it. A seedling is deposited in the opening and then the soil is put back in the same position and packed mechanically. So thorough is the job that it is difficult to tell where the ground has been disturbed. Trees are spaced about 2.5 m. apart.

YUGOSLAVIA.—Plans for 1947 to 1951 throw interesting lights on the methods this country intends to employ both to improve forest production and to develop its timber industries. It shows notably that fellings in 1951 will amount to 18.5 million m^3, only 84 percent of the corresponding figure for 1939. Of this amount, 8,500,000 m^3 will serve to meet industrial needs, as against 9,500,000 m^3 in 1939. Nevertheless, rational utilization of good quality wood on the one hand and of wood waste and shavings on the other, as well as the development of furniture-making pulp mills and allied industries, is expected to increase production in certain branches, as shown by the following summary:

I. Timber Industry

Product	Production in 1939	Production in 1951	Increase (percentage)
Sawn timber (1,000m^3)	.....	1,650	.....
Plywood (m^3)	18,500	48,400	252
Furniture (finished goods)	[1]10,494	41,000	391
Hydrolized wood (m^3)	.....	4,800	.....
Impregnated ties (m^3)	[1]1,200	6,000	500
Wood fiber products (tons)	.....	32,000	.....

[1]1946 figure.

II. Pulp Industry

Product	Production in 1939	Production in 1951	Increase (percentage)
Paper (tons)	50,210	145,000	289

The Five-Year Plan provides for the reforestation of 100,000 hectares of cut-over, burned-over, arid, or rocky areas and for regular management plans for at least 3 million hectares of forests. Research work is to be greatly encouraged both in wood technology and in silviculture. Finally, forest roads, skid trails, and means of transport are to be provided (250 km. of roads for tractors, 700 km. for lorries; 200 km. of narrow-gauge railways and 50 km. of cable railways). Felling and loading are to be mechanized insofar as possible.

CONVERTING FACTORS

Converting factors shown in Tables 2 - 5 have been approved for the use of FAO by two international conferences on forest statistics, held in Washington and Rome in 1947.

These factors are averages, adopted by agreement. However, if any country considers that serious errors in the conversion of its statistics will arise through use of these standardized factors, FAO will be prepared to use specific factors recommended by that country in converting its statistics.

A.—GENERAL MEASURES

Table 1.—STANDARD UNITS[1]

LENGTH	1 centimeter	= 0.3937 in.		1 inch	= 2.540 cm.
	1 meter	= 3.281 ft.		1 foot	= 0.3048 m.
	1 meter	= 1.094 yd.		1 yard	= 0.9144 m.
	1 kilometer	= 0.621 mile		1 mile	= 1.609 km.
	1 yard = 3 feet = 36 inches			**1 mile = 1,760 yards = 5,280 feet**	
AREA	1 cm^2	= 0.155 sq. in.		1 sq. in.	= 6.452 cm^2
	1 m^2	= 10.76 sq. ft.		1 sq. ft.	= 0.0929 m^2
	1 km^2	= 0.3861 sq. mi.		1 sq. mi.	= 2.59 km^2
	1 hectare	= 0.003861 sq. mi.		1 sq. mi.	= 259 ha.
	1 hectare	= 2.471 acres		1 acre	= 0.4047 ha.
	1 square kilometer = 100 hectares			**1 square mile = 640 acres**	
VOLUME	1 cm^3	= 0.061 cu. in.		1 cu. in.	= 16.39 cm^3
	1 m^3	= 35.31 cu. ft.		1 cu. ft.	= 0.02832 m^3
	1 liter	= 61 cu. in.		1 cu. in.	= 0.01639 liter
	1 liter	= 0.2642 gal. (U.S.)		1 gal. (U.S.)	= 3.785 liters
	1 liter	= 0.2200 gal. (Imp.)		1 gal. (Imp.)	= 4.546 liters
	1 liter = 1,000 cm^3			**1 gallon = 4 quarts**	
MASS	1 kilogram	= 2.205 pounds		1 pound	= 0.4536 kg.
	1 metric ton	= 1.102 short tons		1 short ton	= 0.9072 metric ton
	1 metric ton	= 0.9842 long tons		1 long ton	= 1.016 metric tons
PRESSURE	1 kg. per m^2	= 0.2048 lb. per sq. ft.		1 lb. per sq. ft.	= 4.882 kg. per m^2
	1 gm. per cm^2	= 0.0142 lb. per sq. in.		1 lb. per sq. in.	= 70.31 gm. per cm^2
DENSITY	1 kg. per m^3	= 0.06243 cu. ft.		1 lb. per cu. ft.	= 16.02 kg. per m^3
OTHER	1 m^2/ha.	= 4.356 sq. ft./acre		1 sq. ft./acre	= 0.2296 m^2/ha.
	1 m^3/ha.	= 14.29 cu. ft./acre		1 cu. ft./acre	= 0.07 m^3/ha.

[1]Inches, feet, yards, and miles are U.S.A.:British units.

B.—FOREST PRODUCTS MEASURES*

Table 2.—WEIGHTS

Product	Unit	Average Weight Shipped by Rail		Kilos per Cubic Meter	Pounds per Cubic Foot
		Kilos	Pounds[1]		
Sawlogs					
conifers	1,000 board feet	3,300	7,300	650	41
	Cubic meter	650	1,400		
broad-leaved	1,000 board feet	5,100	11,000	975	61
	Cubic meter	975	2,100		
Pulpwood	Cord	1,300	2,900	500	31
	Stere	350	770		
Fuelwood—mixed	Cord	1,800	4,000	700	44
	Stere	490	1,100		
Pitprops	Fathom	2,700	6,000	620	39
T & T Poles	1 piece—European	110	240	650	41
Sleepers					
conifers—Type A[2]	1 piece	62	140	620	39
conifers—Type B[2]	1 piece	52	110	620	39
broad-leaved—Type A[2]	1 piece	90	200	900	57
broad-leaved—Type B[2]	1 piece	75	170	900	57
Sawn lumber					
conifers	1,000 board feet	1,200	2,600	520	32
	Standard	2,400	5,300		
broad-leaved	1,000 board feet	1,700	3,700	730	46
	Standard	3,400	7,500		
Plywood					
Italian and French	Cubic meter	500	1,100	500	31
Austrian, Polish, and Czech	Cubic meter	650	1,400	650	41
Other	Cubic meter	650	1,400	650	41

[1]Calculated from the equivalent number of kilos. Since the figures are approximations and pounds per cubic foot are shown only to two figures, this result may not agree with the result obtained by multiplying pounds per cubic foot by the equivalent number of cubic feet.

[2]Type A sleepers average 10 pieces to the cubic meter; Type B, 12 pieces to the cubic meter.

*Conifers (softwoods) include all woods derived from trees which are classified botanically as gymnosperms. Broad-leaved (hardwoods) includes all woods classified botanically as angiosperms. The species belonging to this group are generally broad-leaved.

Table 3.—Roundwood

Product	Unit[1]	Solid Volume without Bark	
		Cubic Meters	Cubic Feet
Roundwood (general)	Cubic meter	1	35.3
	Cubic foot	0.0283	1
	Load	1.13	40.0
Sawlogs	1,000 board feet }	4.53	160
	1,000 super feet }		
	100 pulgadas	4.81	170
Pulpwood	Cord (128 cubic feet)	2.55	90.0
	Stere } conifers	0.75	26.5
	Raummeter } conifers		
	Russian fathom	6.80	240
Fuelwood	Stere (conifers)	0.70	24.7
	Stere (broad-leaved)	0.65	23.0
	Cord (128 cubic feet)	2.12	75.0
	Russian fathom	5.66	200
Charcoal Wood	Metro linear	0.71	25
Pitprops	Fathom (216 cubic feet)	4.46	158
T & T Poles			
North America	1,000 linear feet	15.4	545.0
	1 piece	0.43	15.2
Europe	1 piece (conifers)	0.165	5.83

[1]Units are grouped opposite the products for which they are most commonly used, but certain units are applicable to a variety of products.

Table 4.—Processed Wood

Product	Unit	Solid Volume			Roundwood Equivalent	
		Cubic Meters	Cubic Feet	Standard	Cubic Meters	Cubic Feet
Sawn lumber and hewn wood	Standard	4.672	165	1	7.79	275
	1,000 board feet }	2.36	83.3	0.505	3.96	140
	1,000 super feet }					
	Load	1.42	50.0	0.303	2.36	83.3
	100 pulgadas	2.36	83.3	0.505	4.81	170
	Cubic meter	1	35.3	0.214	1.67	59.0
Sleepers	Load	1.42	50.0	0.303	2.58	91.1
	piece—Type A[1]	0.10	3.53	0.0214	0.182	6.43
	piece—Type B[1]	0.083	2.93	0.0178	0.142	5.00
Laths	1,000 pieces	0.195	6.9	0.042	.....	.....
Shingles	1 square	0.16	5.6	0.034	0.453	16.0
Plywood						
Thickness 5 mm.	1,000 square meters	5.00	177	.....	12.5	441
Thickness 10 mm. and over	Cubic meters	1	35.3	.....	2.5	88.3
Thickness ⅜ inch[2]	1,000 square feet	0.885	31.2	.....	1.11	39
Veneers, broad-leaved						
Average thickness 1/10 inch	1,000 square feet	0.235	8.3	.....	0.473	16.7

[1]Type A sleepers average 10 pieces to the cubic meter; Type B, 12 pieces to the cubic meter.

[2]Equivalents for ⅜" plywoods are based on production of softwood plywood from large logs on the west coast of North America.

Table 5.—Pulp and Paper

Product	Unit	Wood Pulp Content	Roundwood Equivalent	
			Cubic Meters	Cubic Feet
Wood pulp—				
Mechanical	Metric ton (air dry)		2.55	90
Chemical	Metric ton (air dry)		5.04	178
Newsprint paper	Metric ton	0.13 tons chemical pulp and 0.92 tons mechanical pulp	3.00	106
Paper other than newsprint	Metric ton	0.68 tons chemical pulp and 0.09 tons mechanical pulp	3.65	129
Building boards (fiber)	Metric ton	Average mechanical pulp about 0.62 tons	1.6	56
Paperboard other than building boards	Metric ton	0.32 tons chemical pulp and 0.07 tons mechanical pulp	1.8	63

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